WEST AFRICAN OIL: WILL IT MAKE A DIFFERENCE?

David C. Underwood

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

WEST AFRICAN OIL:
WILL IT MAKE A DIFFERENCE?

by

David C. Underwood

December 1982

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aggregate analysis of the area's potential for new oil reserves and production capacity are also presented. Finally, by drawing from the experiences of established oil producers like Nigeria, the economic and political implications of the widespread development of petroleum resources in West Africa are projected at the domestic and regional levels. Specifically, will newfound oil wealth help resolve existing problems, or will it magnify them? The study concludes that for most of these countries, oil wealth will be a mixed blessing.

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West African Oil: Will it Make a Difference?

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ABBREVIATIONS

bbl	Barrels
b/d	Barrels per day
cfd	Cubic feet per day
cu. ft.	Cubic feet
GDP	Gross domestic product
LNG	Liquified natural gas
OPEC	Organization of Oil-Exporting Countries
sq. km.	Square kilometers

I. INTRODUCTION

In the 1950s, petroleum became the world's dominant source of commercial energy, and in the ensuing twenty years it was universally embraced as the fuel with almost ideal characteristics -- it was convenient, abundant and inexpensive. However, in 1973 the Organization of Petroleum Exporting Countries (OPEC) abruptly and permanently ended the era of inexpensive petroleum, and in the process set off a series of international economic shockwaves that have reverberated for almost a decade. The OPEC action also fostered a series of debates concerning the abundance of the world's petroleum supplies. These debates have become increasingly relevant as industrialization and modernization have forced many developing countries to compete with the developed countries for scarce international energy resources. It has now become evident that current world petroleum reserves will not be sufficient to satisfy the growing worldwide energy demands indefinitely.

Due to the sharp increase in petroleum prices since the 1973 OPEC oil embargo and the continuing political instability in the Middle East, the free world's industrialized oil-importing countries have become increasingly anxious to diversify their petroleum supply lines away from the troubled Arabian Gulf. As a result, many major U.S. and European oil

companies have mounted massive petroleum exploration campaigns into hostile frontier regions that were once considered to be unfeasible for commercial exploitation. One such area is West and Central Africa. Major new discoveries in the Ivory Coast, Cameroon, Congo, and Angola have touched off a feverish search for petroleum reserves all along West Africa's coast, as well as in some of West and Central Africa's more remote interior regions.

Only a few years ago the potential of Sub-Saharan Africa as a significant source of crude oil was judged to be poor. For example, it took the entire continent of Africa from 1911 until 1963 to produce its first billion barrels of oil; however since 1956, the West African region alone has produced over ten billion barrels of crude oil. [Ref. 1: p. 202] Now there appears to be significant petroleum deposits all along the West African littoral, and currently drilling activity is underway or planned in virtually every coastal nation from Senegal to Angola and inland from Mali to Zaire (see Figure 1). Based on the high level of activity and the massive investments being made to underwrite the exploration and development of West Africa's petroleum reserves, it appears that the region has moved into third place, behind North America and the Middle East, in the geological exploration interests of many U.S. and European oil companies.

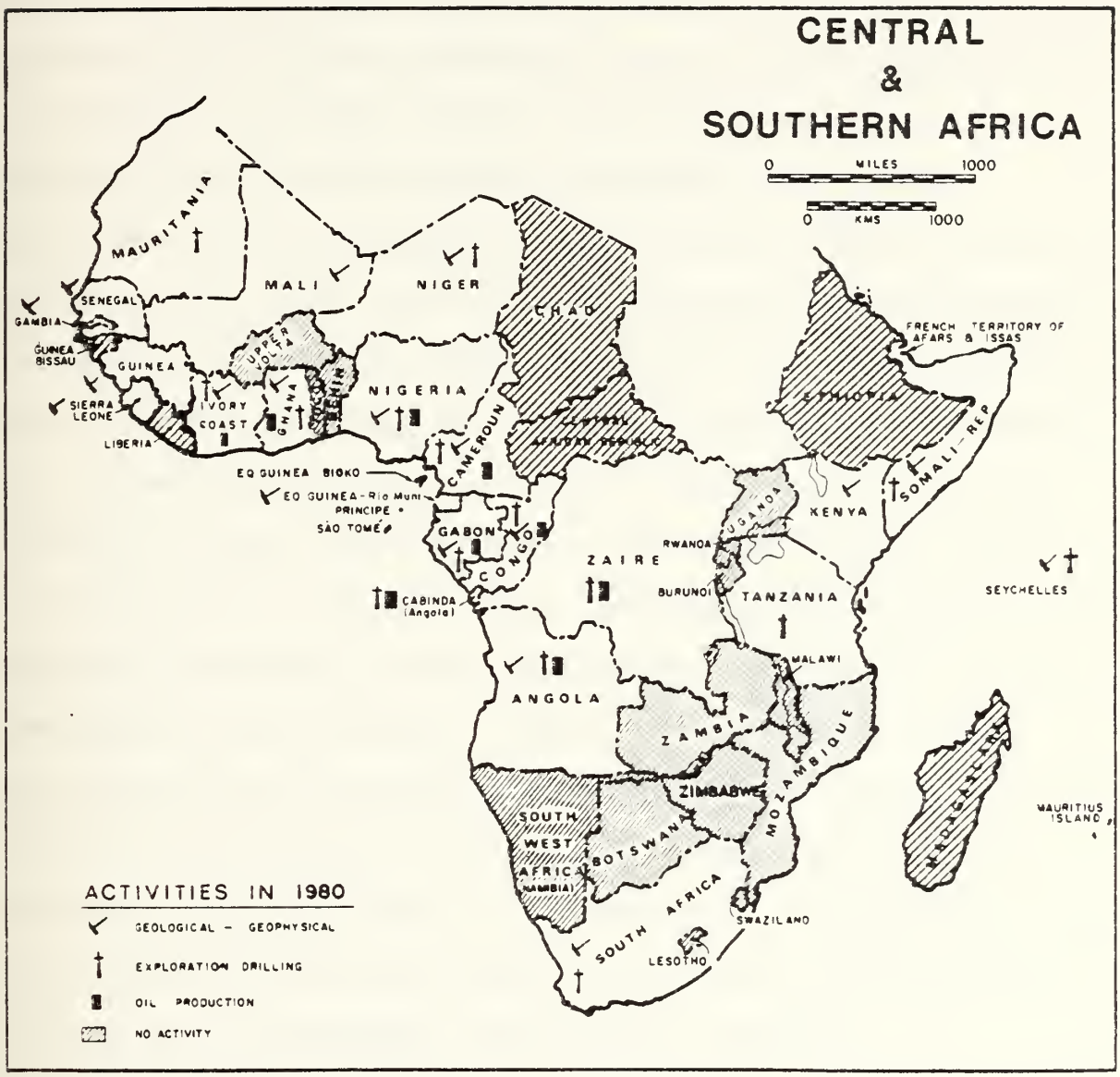

Figure 1. Sub-Saharan Africa: exploratory activity in 1980. Reprinted by permission of the American Association of American Geologists. [Ref. 2: p. 2085]

Although no one expects another Nigeria, some petroleum experts are predicting that the boom area for the oil industry in the coming decade will be West Africa. By world standards, the recent discoveries are not large; nevertheless even modest production levels could have the potential to dramatically alter the region's economic and political structures and relationships. Small scale exports of petroleum products could allow some of these countries to re-establish favorable balances of trade, off-setting the disastrous drain placed on their developing economies by rising international oil prices and high interest rates. Even without new discoveries -- which seems unlikely, given the present levels of exploration -- non-OPEC West African nations could be exporting, according to most estimates, 500,000 b/d or more sometime in the mid-1980s. [Ref. 3: p. 1] Several West African nations also possess the potential to export significant amounts of natural gas; however the region's natural gas reserves, even more than its oil reserves, are dependent upon rising natural gas prices and the emergence of new markets to make their development economically feasible.

Some Africanists regard the exploitation of West Africa's oil resources as the ushering in of a "Brave New World." They argue that it is a second chance for these countries to achieve political and economic independence, to achieve domestic and regional stability, and to achieve true national development with a higher standard of living for all. There

are others who argue that under the bravest of new worlds nothing will change. They question whether any amount of oil wealth would be sufficient to overcome the forces at work in most African countries that make political and economic development problematic at best; instead, they maintain that oil revenues will tend to exacerbate existing problems, both domestically and regionally.

Regardless of where the truth lies, to properly analyze the political and economic implications of the development of West Africa's petroleum resources, the region's true petroleum potential must be determined. Chapter Two of this study surveys the petroleum potential of West Africa's eight established petroleum producing countries: Angola, Cameroon, Congo, Gabon, Ghana, Ivory Coast, Nigeria, and Zaire; Chapter Three surveys the potential of three countries in the region who are attempting to emerge as petroleum producers: Equatorial Guinea, Senegal, and Togo-Benin; and Chapter Four evaluates eight West African countries which are believed to possess some potential for petroleum production: Chad, Niger, Central African Republic, Mali, Guinea, Guinea-Bissau, Liberia, and Sierra Leone. Each of the twenty countries is treated seperately beginning with a short summary of the country's current petroleum exploration, development, and production activity, its proved reserves are presented and its potential

for new reserves and future production capacity are estimated.* Chapter Five evaluates the physical and political constraints upon the development of the region's petroleum resources; and Chapter Six provides an aggregate analysis of the area's potential for new reserves and production capacity.

Finally, Chapters Seven and Eight analyze some of the economic and political implications posed by the development of West Africa's hydrocarbon resources. Specifically, the chapter addresses the following four questions: Will the development of oil production throughout West Africa effectively help resolve the domestic problems of hunger, unemployment, health, and education? Will it promote regional stability? Will it lead to greater political and economic independence? Or will it continue to be -- as in most oil producing countries -- a "profit pump" capable, in a short lapse of time, of exhausting the region's oil reserves without solving the burning questions for the people of this region?

---

*Since decisions to expand production capacity are made on the basis of estimates of future demand and prices for petroleum products, projections of production increases are speculative and subject to change. The reader must bear in mind that the estimates contained in this monograph are contingent upon favorable international market conditions, and that current development targets will be achieved.

II. ESTABLISHED PETROLEUM PRODUCING COUNTRIES

A. ANGOLA-CABINDA

1. General

Commercial quantities of oil were first discovered in Portuguese Angola in 1955. [Ref. 4: p. 2] In 1960, Gulf Oil Corporation began seismic surveys which led to drilling and development work in the Cabinda enclave. By 1968, Angola's production amounted to an average of 30,000 b/d from 113 wells; output increased to 125,000 b/d in 1972, and peaked at 150,000 b/d in 1974. [Ref. 5: p. 5] Portuguese withdrawal, following independence, left wide gaps in technical and commercial skills, while the continuing civil war exacerbated the country's economic problems. In December 1975, Gulf suspended production for security reasons, but by April 1976, the Marxist MPLA government reached an agreement with Gulf to resume operations. Crude oil production in Angola has not averaged less than 100,000 b/d since 1974, in spite of the country's almost continuous state of turmoil, and today, petroleum exports account for almost 80 percent of the country's foreign exchange earnings. [Ref. 4: pp. 1-7; 6: p. 36]

The state oil company, Sociedade Angolana de Combustiveis (SONANGOL), founded in 1976, holds the key to exploration and production in Angola. In 1978, the government

published a petroleum law which gave SONANGOL ultimate control over petroleum exploration and exploitation. Since the 1978 law, discoveries are the property of the state, and concessions are a thing of the past. Clearly, this means that foreign oil companies must be in partnership with the Angolan government, limited by law to two types of agreements: either the joint venture type, in which the Angolan government holds a minimum of 51 percent of the shares (compared to 16.67 percent in 1976); or agreements covering the sharing of production, in which the government's percentage varies, based on a distribution of 60 percent (minimum) for the government and 40 percent for the foreign company. [Ref. 7: p. 2461]

Presently, the Angolans recognize the need for Western expertise and direct investment in their development effort and have tried to smooth the way for foreign interests. However, the Angolans are working to develop SONANGOL into a fully-fledged exploration, production, and international petroleum marketing company. [Ref. 8: p. 54-55] In addition, Angola, which has so far chosen not to join OPEC, has attempted to persuade Gabon and Nigeria to join with it in forming a West African Oil Producer's Association. [Ref. 9: p. 11] Thus, the situation for foreign investors could be modified if Angola acquires the ability to sustain independent operations.

2. Production and Exploration

With 190 producing wells, Angola's crude oil production dropped from 160,000 b/d in 1980 to 140,000 b/d

in 1981. According to the Director-General of SONANGOL, the production slump was due to "technical operating problems," however, he predicted an average production rate of 200,000 b/d in 1982, which would place Angola in fifth place among African producers, behind Nigeria, Libya, Algeria, and Egypt. [Ref. 10: p. 7; p. 2461] Approximately two-thirds of Angola's crude oil production is from the Gulf Oil offshore holdings in Cabinda (see Figure 2); most of the remainder is produced onshore in Angola proper. The specific breakdown of production rates by area is shown in Table One.

Table 1

ANGOLAN CRUDE OIL PRODUCTION*

AREA	RATE (b/d)	PERCENT
Cabinda	85,000	61.0
Congo Basin**	40,000	28.0
Block 2	11,000	8.0
Kwanza Basin**	4,000	3.0
	140,000 b/d	100.0%

*As of Feb. 1982
**Onshore

[Ref. 11: p. 1]

As of July 1981, the Oil and Gas Journal reported only three companies with commercial crude oil production in Angola: PETROFINA (Belgium) with 43,009 b/d, Gulf Oil with 86,410 b/d, and Texaco with 2,289 b/d. [Ref. 12: pp. 99-100] In the past Gulf Oil has been predominant in production activities, but now the government has granted new exploration

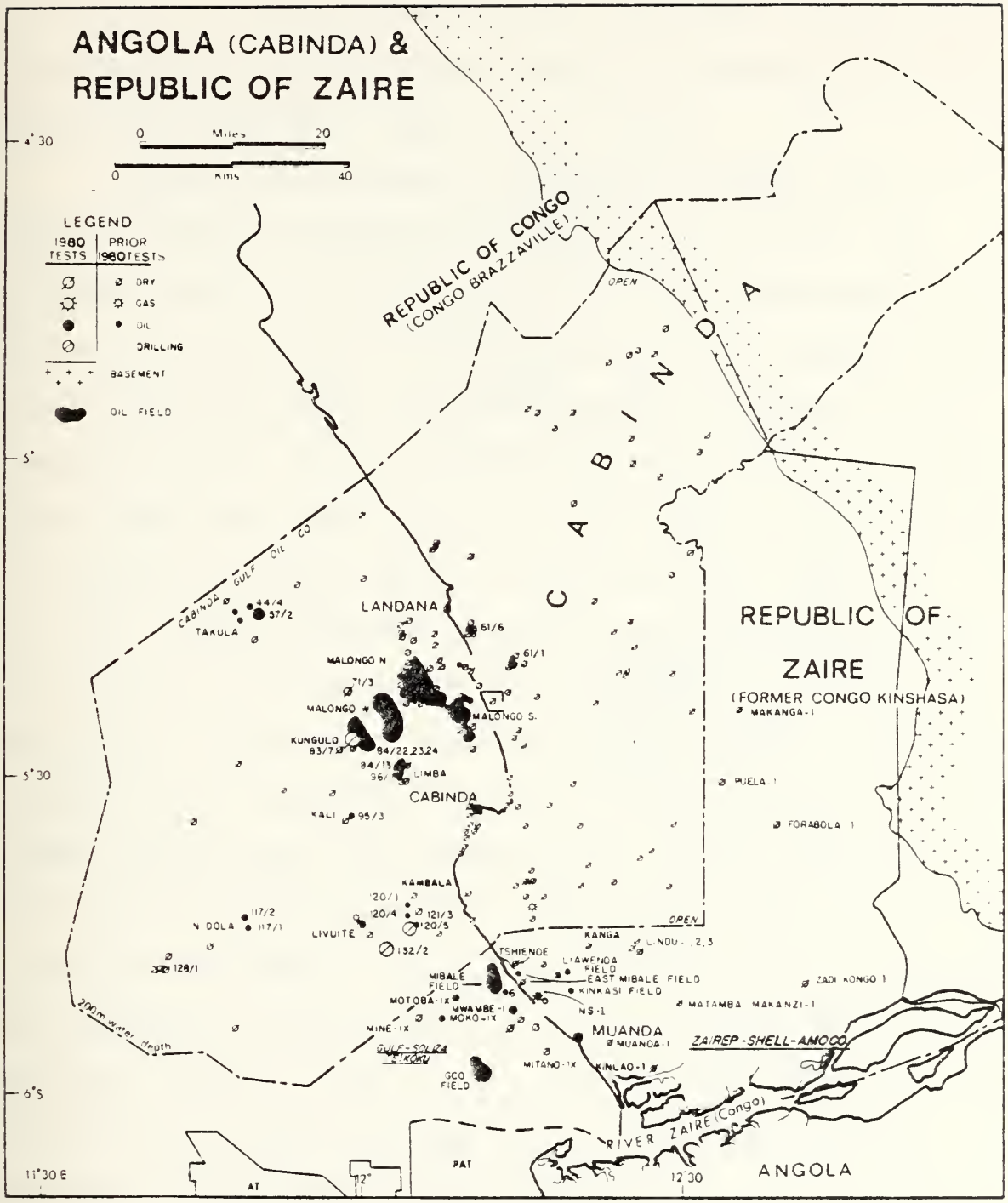

Figure 2. Angola-Cabinda and Republic of Zaire: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2090]

blocks in northern and central offshore waters to a host of concerns. As of September 1981, seventeen companies had signed, or were about to sign exploration/production agreements with SONANGOL. [Ref. 8: pp. 54-55]

Angola has divided its offshore acreage into 14 blocks, numbered consecutively from north to south (see Figures 3 and 4). Currently there is significant activity in seven of the blocks, as well as in the two onshore areas in the Congo and Kwanza Basins. Investor interest in the remaining blocks for oil exploration is strong. In January 1982, there were eight drilling rigs exploring Angolan waters, a 50 percent increase over the previous year. [Ref. 13: p. 178] Industry sources maintain that two to three times as many rigs could be employed in West Africa if they were available. For example, Gulf Oil drilled eleven exploratory wells in 1981, and initiated a $1.2 billion five-year development program that could boost their Cabinda production to 200,000 b/d by year-end 1985. The program calls for drilling a total of 185 wells, installation of a $168 million natural gas reinjection system, and the launching of an enhanced recovery program. [Ref. 5: pp. 42-43] Although the Gulf oil operation is by far the largest in Angola, Gulf's competitors are initiating similar capital ventures all along Angola's coast.

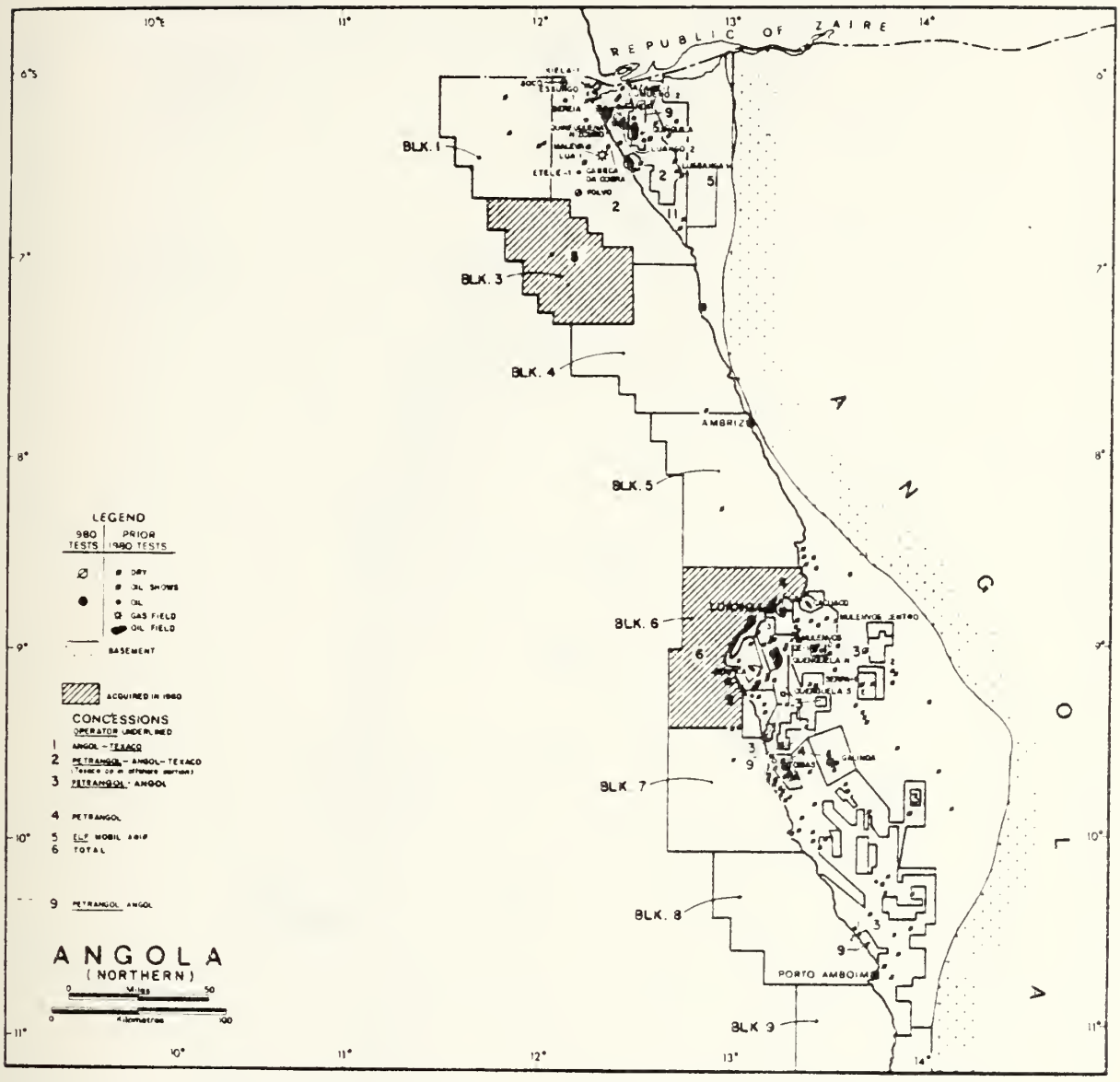

Figure 3. Northern Angola: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2088]

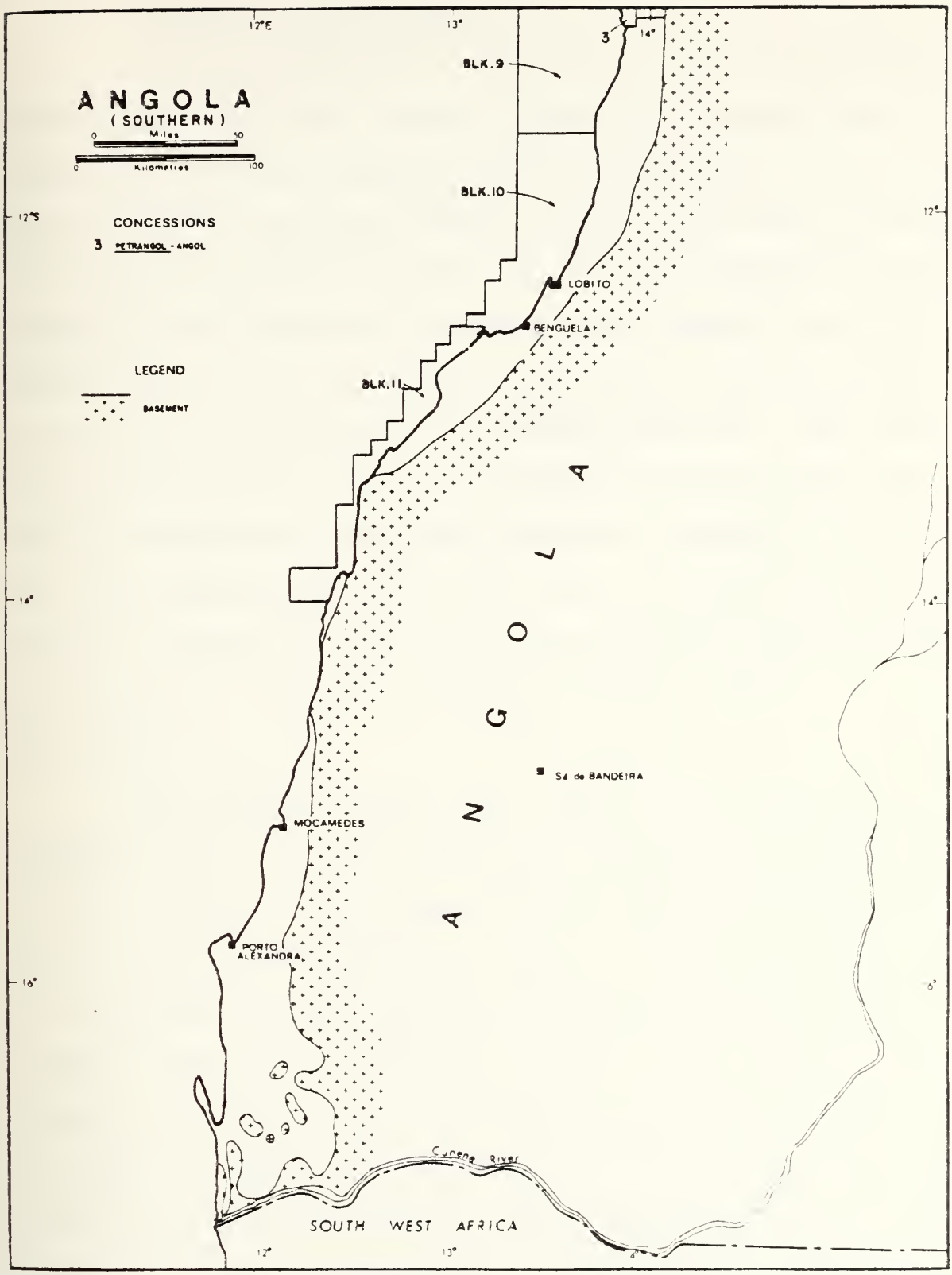

Figure 4. Southern Angola: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2089]

3. Reserves and Potential

Angola's hydrocarbon reserves lie in five sedimentary basins that are either totally or partially located within Angolan territorial boundaries. The Congo Basin is predominantly offshore and runs parallel to the coast from southern Gabon to just north of Luanda. In addition to having Angola's largest proved reserves of crude oil and natural gas, the eastern edge of the basin has a tar belt estimated to contain several billion barrels of hydrocarbon reserves. The Cuanza Basin occupies the central one-third of Angola's coastline and has some minor established production onshore. Owing to its many geological similarities with the Congo Basin, this basin is thought to have good future potential, particularly in its largely unexplored offshore regions. [Ref. 11: pp. 1-18]

The Mocamedes Basin lies south of the Cuanza Basin, extending along Angola's shoreline into Namibia's territorial waters. This basin is almost totally unexplored, but based on its geological similarities with the basins to the north it is thought to have definite hydrocarbon potential, and several firms are negotiating for exploration rights. The remaining two basins are the Congo Fan which lies offshore adjacent to the western boundaries of the Congo and Cuanza basins, and the Estosha Basin which occupies southwest Angola and parts of Zaire and Namibia. Both basins are relatively unexplored and their potential is unknown. [Ref. 11: p. 1-18]

Angola has estimated proved reserves of 1.45 billion bbl of crude oil and 1.03 trillion cu. ft. of natural gas. [Ref. 12: 87] While offshore reserves account for almost 70 percent of Angola's present production, sizeable onshore reserves extend about halfway down the coastline. Even though the Angolan government is conservative about reserve depletion, it seems equally anxious to develop the country's petroleum potential. Based on present trends, the current production of 160,000 b/d is predicted to climb to 200,000 b/d in 1982, and by 1985 reach a sustained level of 300,000 b/d, with a maximum production capacity in excess of 400,000 b/d. [Ref. 14: p. 1147] Crude oil reserves are also expected to rise to 1.86 billion bbl during the same period. [Ref. 11: p. 18]

B. CAMEROON

1. General

Cameroon became Africa's twelfth oil producer and a member of the oil exporter's club when its Kole Marine field went on stream in November 1977 at a rate of 5,000 b/d. [Ref. 9: p. 16] Elf Aquitaine pioneered Cameroon's oil industry by exploring the swampy onshore area around Douala from 1951 to 1959, where non-commercial shows of oil and gas were found. Elf shifted its search to the offshore Rio del Ray permit in 1963 and found Cameroon's first field, Betika, but it was the Kole field, discovered two years later, that produced the first oil. [Ref. 15: pp. 54-55] Those two

finds triggered the discovery of a clutch of fields in the same area that boosted Cameroon's production from almost zero in 1977 to an estimated 56,767 b/d in 1980. During the 1979-80 fiscal year, Cameroon's oil exports increased by 92 percent in volume, and 261 percent in value over the 1978-79 period. The oil revenues contributed directly to a six percent real rate of growth for the nation's economy, and along with agricultural products generated approximately 76 percent of Cameroon's 1979-80 export earnings. [Ref. 16: p. 63; 17: p. 2]

Cameroon's 1978 petroleum legislation provided the legal framework for the formation of the state-owned oil company, Ste. Nationale des Hydrocarbures (SNH), which was established in 1980. Cameroon's nationalistic petroleum policies are implemented under the auspices of SNH, and the company is responsible for all negotiations with foreign oil companies. [Ref. 15: p. 54] SNH has assumed principle control of Cameroon's petroleum industry by taking a 50 percent interest in all exploration permits, while its equity share of production permits is 60 percent for the first 15 million tons (100,000 b/d) of annual output, 65 percent of the next 15 million tons, and 70 percent of all production above 30 million tons. [Ref. 18: p. 44-45] Officials of major U.S. oil companies with operations in Cameroon, who were interviewed for this study, remarked that the Cameroonians drive hard bargains, but they are straight-forward and businesslike in their dealings. In the view of these officials the major

problem has been getting the Cameroonians to recognize that the large sums expended by foreign oil firms in exploration and development must be recovered after a field is brought on stream to finance new operations.

Despite these problems, Cameroon is probably the fastest growing West African oil area. Perhaps the best barometer of the country's growth is the increase in interest shown by non-oil-sector investors. Since 1978, the Chase Manhattan Bank, First National Bank of Boston, and Banque de Paris et des Pays-Bas have joined the four French-owned foreign banks in Douala. Bank of America has applied for permission to open an affiliate and Citibank has expressed a desire to do likewise. [Ref. 3: p. 1]

2. Production and Exploration

Although Cameroon has been a net exporter of crude oil since 1977, it was a net importer of refined petroleum products until its first refinery began operating in 1980. [Ref. 15: p. 54] Almost all crude oil production comes from offshore fields operated by Elf-Serepca of the Elf Aquitaine group in partnership with Pecten Cameroon, a Shell affiliate. Cameroon, with 81 wells producing, racked up a 48 percent gain in 1981, pushing its production up to 87,000 b/d; and the 1981 finds, that will add Mobil and the French firm, CFP-Total, to the producer ranks, makes future prospects even brighter. [Ref. 9: p. 18; 12: p. 85] During the 1981-82 oil glut, the pragmatic Cameroonians cut their oil export

prices rather than see production plummet, consequently, production forecasts for 1982 are in the 100,000 b/d range. [Ref. 19: p. 26] In 1981, there were six producing oil fields; production rates are shown below in Table 2.

Table 2

CAMEROON'S OIL PRODUCTION

AREA*	RATE (b/d)**	PERCENT
Betika	9,271	10.86
Ekoundou North Center	16,146	18.92
Ekoundou South	9,340	10.94
Kole	12,171	14.26
Kombo North	4,485	5.25
Kombo South Center	33,951	39.77
	85,364	100.00

*all fields are offshore
**b/d average first six months of 1981.

[Ref. 12: p. 105]

Despite brisk exploration in 1980, there were no major oil discoveries. During 1980, Elf completed the development phase of the Ekoundou Sud and Betika Sud fields; Ekoundou Nord and Kombo Central fields are still in develment. In 1981, development was completed on Kombo Nord and work began on Ekoundou Central and Boa fields (see Fig. 5). [Ref. 15: p. 55] However, a large discovery by a Mobil/Total group made 1980 a big year for natural gas. [Ref. 20: p. 194] This was followed in 1981 by an Elf find in the Edoundou field and another large discovery by Gulf off Douala (see Fig. 6). Both of these discoveries were outside established gas regions, indicating that Cameroon's natural gas deposits may be more

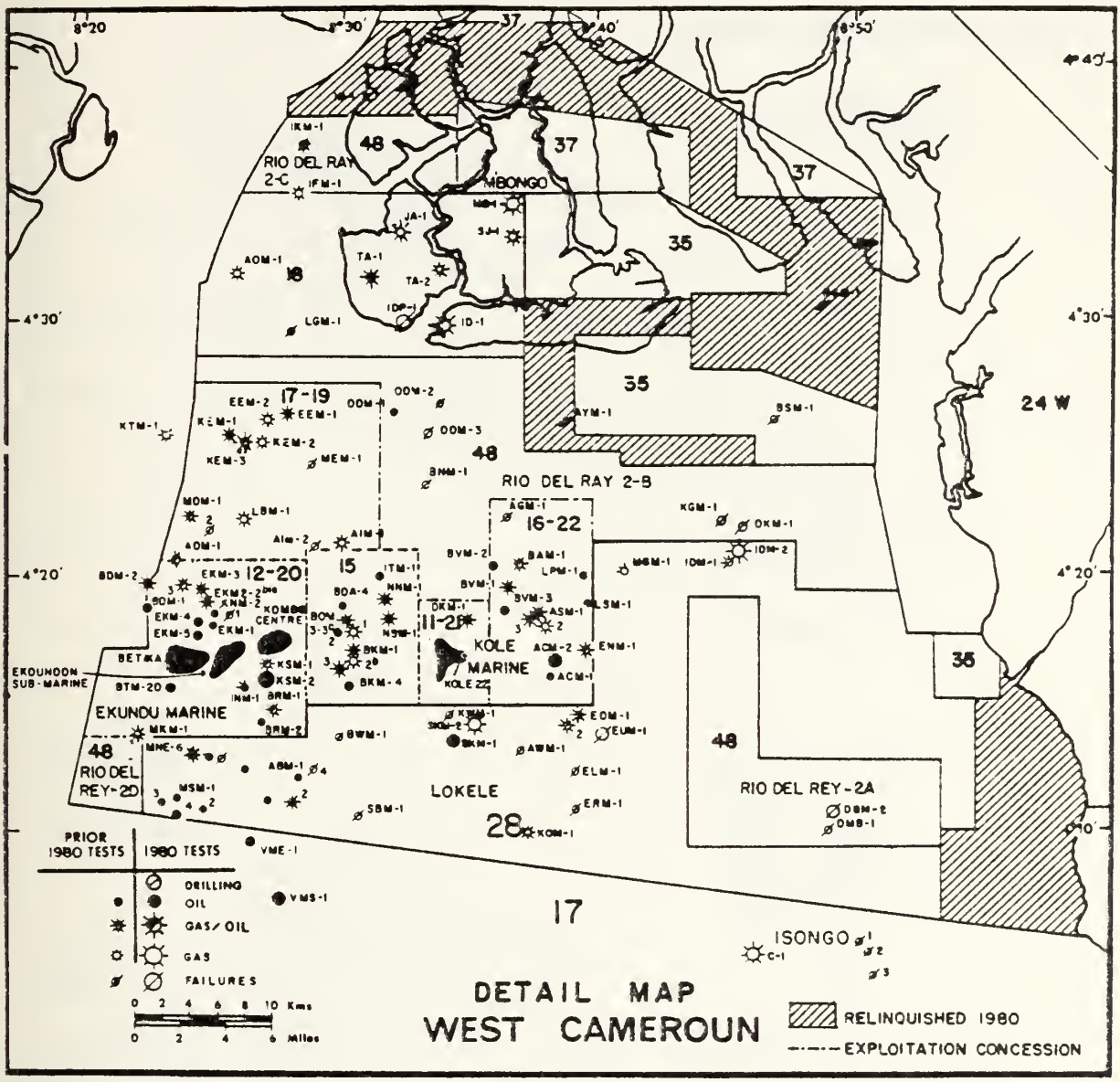

Figure 5. West Cameroon: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2095]

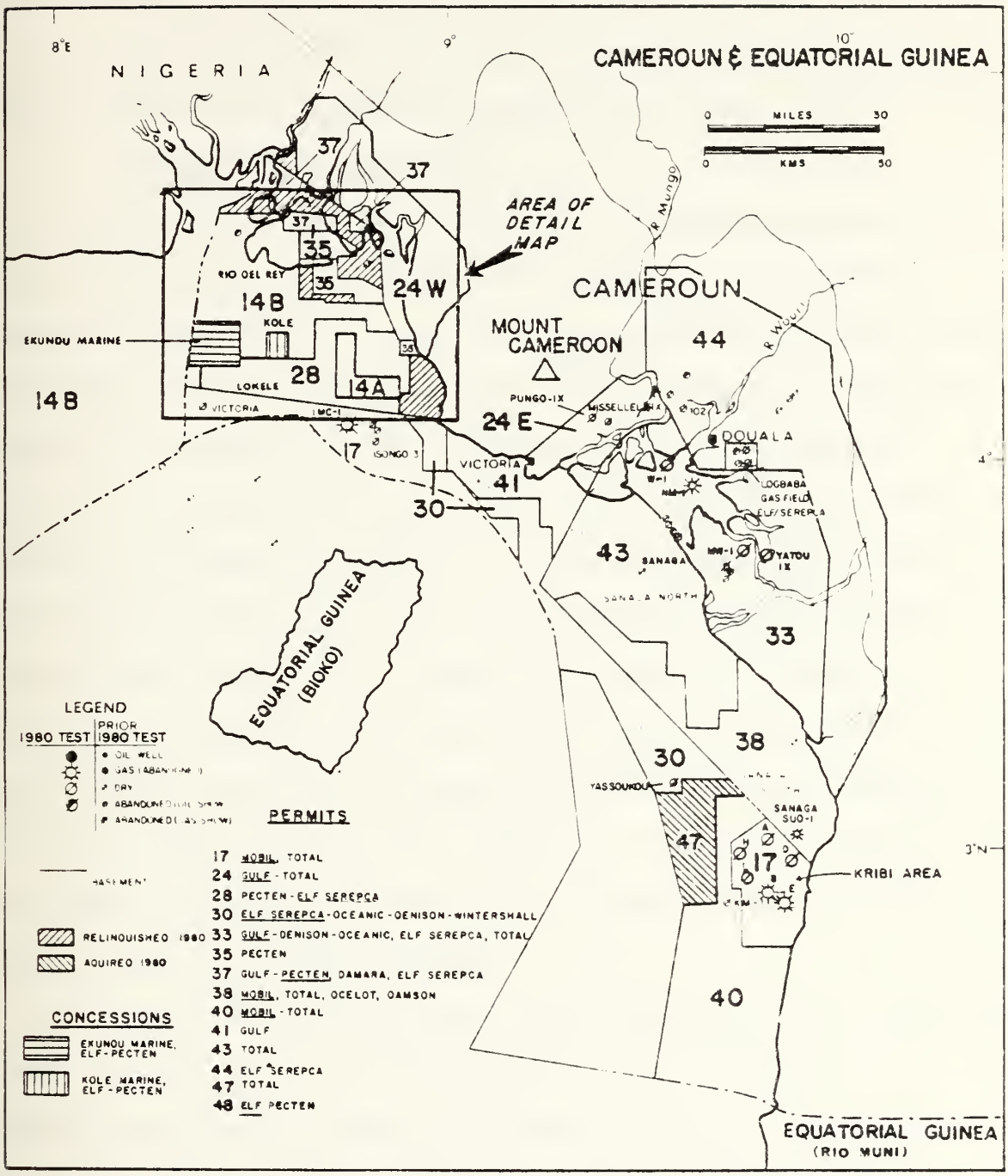

Figure 6. Cameroon and Equatorial Guinea: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2094]

extensive than originally supposed, [Ref. 9: pp. 16-17] Exploration in 1981 by Gulf, Mobil, Shell, Total, and Elf boosted the active rig count from four to eight, and could double Cameroon's production capacity by 1985. [Ref. 21: p. 86]

3. Reserves and Potential

Cameroon has parts of three sedimentary basins with known hydrocarbon potential. The majority of Cameroon's current production has come from the Niger Delta Basin, which has some onshore areas, but lies mostly offshore along the northern one-third of the coastline. The remainder of Cameroon's production comes from the Douala Basin, which occupies the central regions. The other area with known potential is the Chad Basin in northern Cameroon, around Lake Chad. [Ref. 22: p. 22-28] In 1981, Elf took two exploration permits covering 18,445 square kilometers in this region, and has conducted geophysical and aeromagnetic surveys. [Ref. 15: p. 56] Cameroon is located between OPEC producers, Nigeria and Gabon, and shares the same sedimentary basins from which they produce.

In 1981, Cameroon more than tripled its oil reserves, from 140 million bbl to 480 million bbl, and raised its natural gas reserves from 13 billion cu. ft. to 4.6 trillion cu. ft. -- with new fields, both on and offshore. [Ref. 12: p. 90] In addition, Mobil's Victoria discovery, near Elf's northern fields, appears to have the potential to significantly boost reserves again, and may produce as much as 100,000 b/d.

[Ref. 15: p. 57; 23: p. 18] It is estimated that Cameroon's current reserves will last 25 years, and with the fields in development coming on stream, production should reach 200,000 b/d in 1985. [Ref. 17: p. 9]

But Cameroon's future may lie with natural gas and not oil. According to one report, Gulf's discovery off the central coast may have raised gas reserves by 5.2 to 6.3 trillion cu. ft. [Ref. 23: p. 18] However, it was the 1979 discovery of major gas fields by a Mobil/Total consortium, only 10 kilometers north of Kiribi, that swept natural gas into the spotlight. The gas fields prompted the government to begin feasibility studies for a liquid natural gas (LNG) plant. [Ref. 3: p. 1] At present Mobil, CFP-Total, Gulf, Shell, and Elf all have interests in significant gas discoveries. The Mobil find alone is reported to have reserves of well over one trillion cu. ft., and Mobil and Total are busy with three rigs exploring other promising prospects in the region. [Ref. 15: p. 57]

For the past year, SNH and the foreign operating companies have been trying to prove-up enough gas reserves to justify the construction of a $4 billion LNG complex. Elf has shown confidence in the project by converting six of its exploration permits into gas production permits. [Ref. 15: p. 56] Under one plan, it was estimated that by 1987 Cameroon could have been exporting 500 million cu. ft. of LNG daily -- enough to supply Maryland's needs for a year.

[Ref. 16: p. 55] The final decision for construction, which was to come in the summer of 1982, has been postponed pending further studies to determine whether Cameroon's natural gas reserves are large enough to justify the expense of even a small LNG facility. [Ref. 17: p. 14]

C. CONGO

1. General

Prospecting for oil in the Congo dates back to 1957 when this country was still one of the four territories of French Equatorial Africa. The French-owned Elf-Aquitaine discovered the Pointe Indienne oil and gas field in the on-shore coastal area, and by 1960, the newly independent People's Republic of Congo was producing 1044 b/d of crude oil. [Ref. 9: p. 21] Pointe Indienne's output, which had declined from 1423 b/d in 1965 to 281 b/d in 1971, was supplanted in 1972 by the newly discovered Emeraude offshore deposits, pushing production up to 6,700 b/d. Since then, production has slowly increased, reaching 66,472 b/d in 1980. [Ref. 24: p. 2800] Elf and its subsidiary, Elf-Congo, were the Congo's sole producers until Agip-Congo, subsidiary of Italy's state-owned Agip, brought Emeraude on stream. Today, 99.7 percent of the Congo's production is derived from activities offshore in deep water, where a Getty-led consortium set a world deep water drilling record in 1978 by drilling in 4,346 feet of water. [Ref. 15: p. 65]

The Congo currently ranks low in importance compared with other African producers. Its 60,000 b/d of crude oil produced in 1980 represented little more than 1.1 percent of total African output. [Ref. 23: p. 17] Nonetheless, petroleum has become the Congo's principle export, accounting for 70 percent of the government's receipts in 1980. The oil revenues have reestablished the country's balance of trade, which had shown a chronic deficit until 1973. [Ref. 24: p. 2800]

The Congo has fostered a favorable investment climate to encourage foreign oil companies to explore and exploit the country's oil and natural gas resources. A major attraction has been the 75 percent equity share that the country's national oil company, Hydro-Congo, has allowed to foreign developers. [Ref. 16: p. 58] Instead of taking a share in each of the different operations, in 1980, Hydro-Congo took a 20 percent share of both Elf-Congo and Agip-Congo. The Congo has not adopted OPEC tax and fiscal guidelines, nor ownership provisos; as a result, Elf and Agip have made handsome profits, estimated at $4-$5 per barrel. [Ref. 8: pp. 54-55]

However, the winds of change are blowing. Hydro-Congo plans to increase its equity share in Elf-Congo and Agip-Congo to 30 percent in 1982. The current Congolese hydrocarbon policy has two major objectives: to take gradual control over the energy sector in order ultimately to achieve

economic independence, and to trim excessive windfall profits by having foreign oil companies plough more of their earnings back into the Congolese economy. [Ref. 25: pp. 48-49] In a recently concluded exploration agreement, Hydro-Congo took a 50 percent share in a Cities Service-led consortium and this seems to be the future pattern. [Ref. 9: p. 21] Despite the Congolese government's official adoption of Marxism-Leninism as its guiding philosophy, more and more bankers and businessmen from Europe and the U.S. are now making the trek to Brazzaville, Congo. [Ref. 3: p. 3]

2. Production and Exploration

Production at the Emeraude and Loango offshore fields, in decline for several years, appears to have levelled off in 1980 at 26,000 b/d, but in April 1980 the Congo's production was boosted by 8,000 b/d when the Likouala offshore field came on stream (see Fig. 7). Elf-Congo spent some $400 million to work Likouala up to a 30,000 b/d capacity in 1981, and to lay the groundwork to bring the newly discovered Yanga and Sendji fields on stream in 1981 and 1982. [Ref. 23: p. 17] Overall Congolese production rose to 78,500 b/d in 1981, and the entry into production of Sendji should push output to over 100,000 b/d in 1982. [Ref. 24: p. 2800] A breakdown of production by field is shown in Table 3.

With 153 wells already on stream and 15 exploration rigs jostling one another along a small coastline, production is definitely on the upswing for the Congo's growing offshore

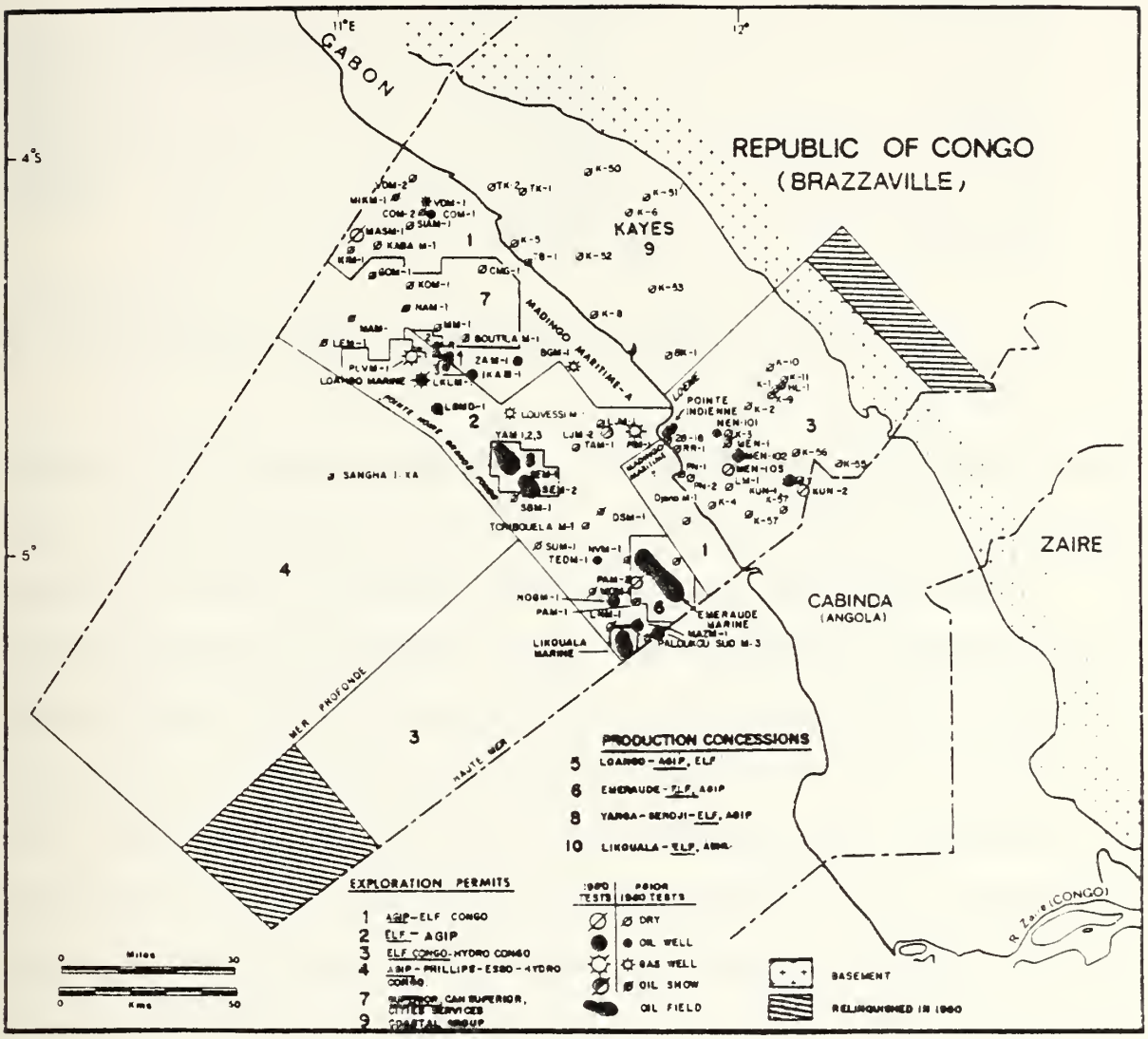

Figure 7. Republic of Congo: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2098]

Table 3

CONGOLESE CRUDE OIL PRODUCTION

FIELD	RATE (b/d)**	PERCENT
Pointe Indienne*	210	.27
Emeraude	30,330	39.37
Loango	24,200	31.41
Likouala	22,100	28.69
Yanga	100	.13
Mengo*	100	.13
	77,040 b/d	100.00%

*Onshore
**b/d average first six months of 1981

[Ref. 12: p. 108]

region. Elf has maintained its leadership in the development race through exploration and by enhancing existing production. Onshore, where Elf began production through its almost depleted Pointe Indienne field, the company is planning to bring Mengo field into production. Elf also plans further drilling on its deepwater permits, where drilling encountered oil shows in 1979. Elf has been disappointed in Emeraude's production, where despite the large reserve, only eight percent of the oil can be extracted by normal recovery methods. [Ref. 24: p. 2800] To correct the problem, Elf is planning to install a steam injection system which facilitates extraction of the heavy 23.3 gravity crude. This will be the first time for this operation to be attempted at sea. [Ref. 25: pp. 48-49]

Several other companies have been attracted to the Congo, and since 1979, U.S. firms have begun to invest in

the search for oil, particularly in the Congo Basin. Cities Service and Canadian Superior Oil have taken a 1,450 sq. km. permit known as Marine Permit One. So far, Coastal Corporation, Agri-Petco International, Ladd Petroleum, Exxon, and Phillips have also taken acreages. [Ref. 15: p. 65]

3. Reserves and Potential

All of the Congo's oil fields are located in the Pointe Noire-Grands Fonds field, which covers the southern third of the country's coastal and offshore region. Parts of three sedimentary basins lie within the Congo's territorial confines: the Congo Basin runs the entire length of the country's coastline and accounts for all current production of gas and oil; the Congo Fan Basin lies offshore beyond the western edge of the Congo Basin, and is largely unexplored; the Zaire Basin runs along the country's eastern border, but its potential is also unknown.

In 1981, the Congo added .5 billion bbl to its proven oil reserves, and natural gas reserves were estimated to be 2.5 trillion cu. ft. [Ref. 12: p. 85] However, recovery of these reserves is difficult because of the complexity of the area's geological formations, low pressure reservoirs, deep water, and sluggishly flowing heavy crude. [Ref. 26: p. 14] As a result, the expansion of Congolese petroleum production is conditioned by the development of better exploration, offshore drilling, and recovery technology. Based on present production trends, favorable market conditions,

and the advent of enhanced recovery techniques, such as Elf's steam injection project, Congolese oil production could top 100,000 b/d in 1982 and reach 200,000 b/d by 1985. [Ref. 9: p. 21]

Also, oil production could be joined soon by the production of natural gas for export. Congo consumes all of the 10 million cubic meters per year it now produces. [Ref. 9: p. 21] Following a new discovery of gas by Elf and Agip offshore from Pointe Noire in 1981, Hydro-Congo formed a new company, Gaz-Congo, to work with Elf and Agip to evaluate the country's natural gas export potential. Hydro-Congo chose Elf to manage the development of a liquid natural gas (LNG) project. [Ref. 6: o. 37] If conclusions are positive and market conditions permit, construction could begin on a liquefaction plant with an annual capacity of six million cubic meters. [Ref. 24: p. 2800]

D. GABON

1. General

France's Elf Aquitaine began petroleum exploration in its colony of Gabon in the 1930's. Early offshore success in the Congo triggered similar activities in Gabonese waters, and Gabon became a producer in 1957 following Elf's discoveries in the Port Gentil area. Gabon's production capacity increased rapidly in the next two decades, finally peaking at 227,450 b/d in 1976. However, output has steadily

declined since 1976, and was down to 178,631 b/d in 1980 -- a drop of over 35 percent. [Ref. 9: pp. 27-28] Even with the decline, Gabon was Africa's fifth largest producer in 1980.

Elf-Gabon, of the Elf Aquitaine group, dominates Gabon's oil industry with over 85 percent of the country's total production; conversely, Gabon is the mainstay in the French company's operations, accounting for approximately 50 percent of Elf's worldwide operations. [Ref. 27: p. 2408] The U.S. affiliate, Shell-Gabon, produces the remainder of Gabon's crude oil. Elf's offshore Grondin field, discovered in 1973, is Gabon's largest and most prolific oil field. It has produced more than any other Gabonese field, including the large Gamba field discovered ten years earlier by Shell. [Ref. 9: pp. 26-27]

Despite declining production rates, owing to rising crude oil prices, Gabon's oil revenues were increasing until 1980. In 1980, Gabon relied on crude oil for 78 percent of its exports, and the oil income generated 50 percent of that year's total GDP. [Ref. 28: p. 4] However, the 1981-82 recession in world crude oil demand caused Gabon's oil earnings to decline, forcing a curtailment of ambitious development projects.

Although Gabon has been a member of OPEC since 1975, in the past its petroleum legislation had been among the most liberal in the world, with company profits of around five dollars a barrel. In addition, Gabon also granted Elf and

Shell an 11.5 percent discount on official OPEC posted prices in late 1981 to provide incentive for continued exploration and production development. [Ref. 8: p. 54-55] Gabon's state oil company, Petrogab, was established in 1979 and designated as the agency responsible for the government's interest in production. Petrogab has shown no interest in independent operations, but it has taken a 25 percent equity share in both Elf-Gabon and Shell-Gabon, and it has started negotiations to increase its capital share in each company to 35-41 percent by the end of 1982. [Ref. 15: p. 58; 29: p. 34-38] Additionally, Petrogab has replaced its system of separate exploration and production permits, with Indonesian-style production sharing contracts which have significantly increased Gabon's share of the profits. For example, Gabon will receive 74.5 percent of the production from Amoco's new well in the Inquessi Marine concession. [Ref. 30: p. 4] Gabon also now requires the foreign oil companies to invest ten percent of their net profits into other sectors of the Gabonese economy such as agriculture. Oil companies are taking a "wait and see" attitude toward Gabon's new demands, but they generally consider the Indonesian-style contracts to be fair and to provide sufficient access to crude. [Ref. 15: p. 58]

2. Production and Exploration

As a result of concerted efforts by the foreign operating companies, earlier predictions that Gabon's crude

oil production would drop to 120,000 b/d in 1981 did not materialize. Both Elf and Shell, who had experienced a sharp decline from their on and offshore fields, took steps to upgrade the production capacity of their existing fields and to accelerate the development of new fields. Elf, which has 19 fields in operation, has five to six rigs engaged in development work alone. Elf's development activities included: more development drilling to boost production at Anguille field, accelerated development of the new Ayol field, the production start up of two new onshore wells, development and test of two more new wells, and completion of development on the new Baudroie Nord field which should achieve 7,000 to 8,000 b/d (see Fig. 8 and 9). Development drilling by Shell restored the production capacity of the Lucina Marine field, and three wells discovered earlier by Gulf were brought on stream at 3,150 b/d. [Ref. 15: pp. 58-59] In all, 27 offshore wells were drilled, of which 22 were development, seven were wildcats, and only five were classified as "dusters," or dry holes. Productive as these efforts were, total well count went from 252 to 250 and Gabon's 1981 output still fell 16 percent to 149,970 b/d. [Ref. 20: p. 196] Although it is not reflected in the annual totals, Table 4 shows that the oil companies did abate the downward trend in Gabon's production capacity, if not enhance it.

While Gabon does not produce natural gas for export, 2.5 billion cu. ft. were consumed domestically in 1980 and

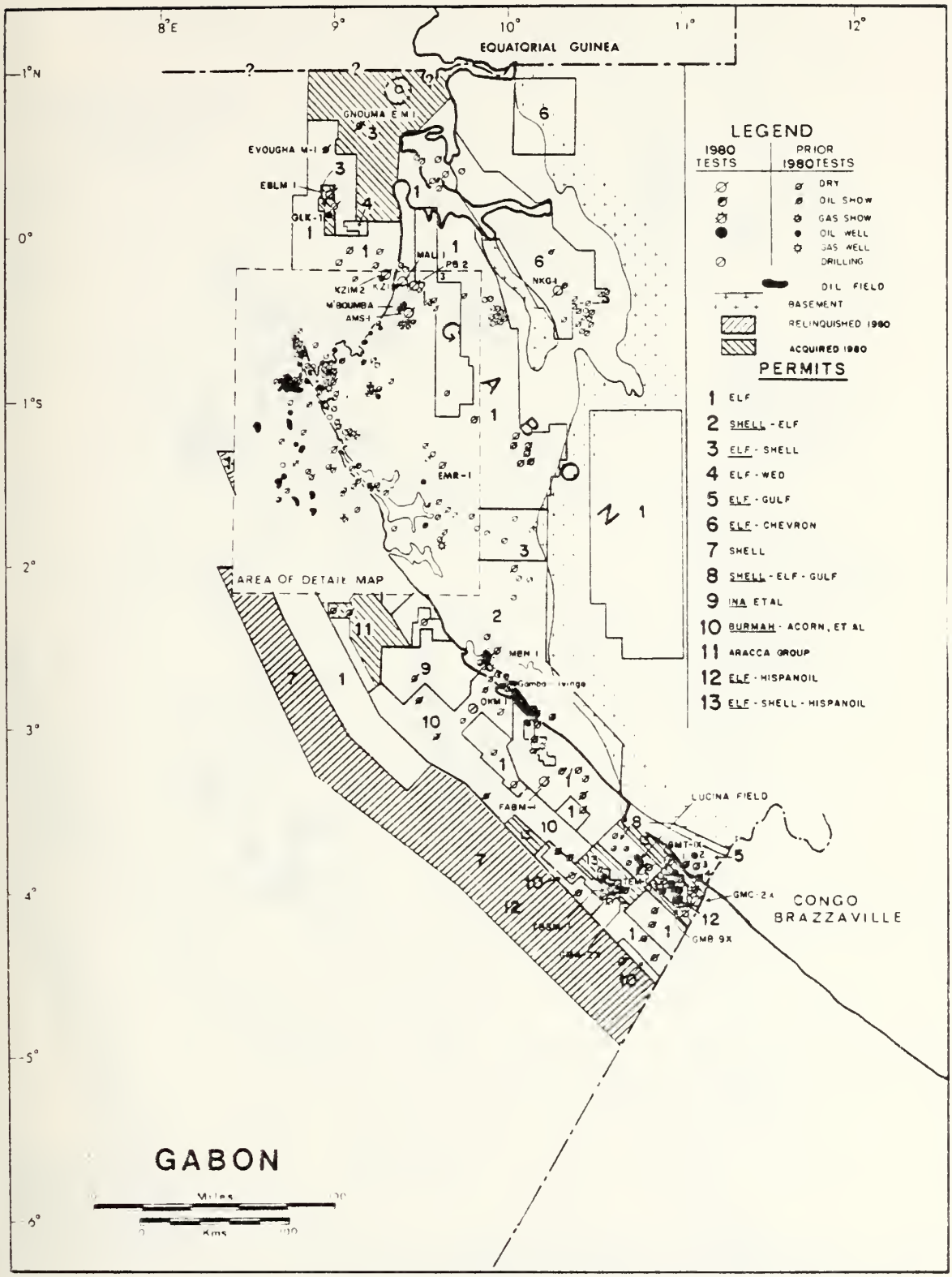

Figure 8. Gabon: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2109]

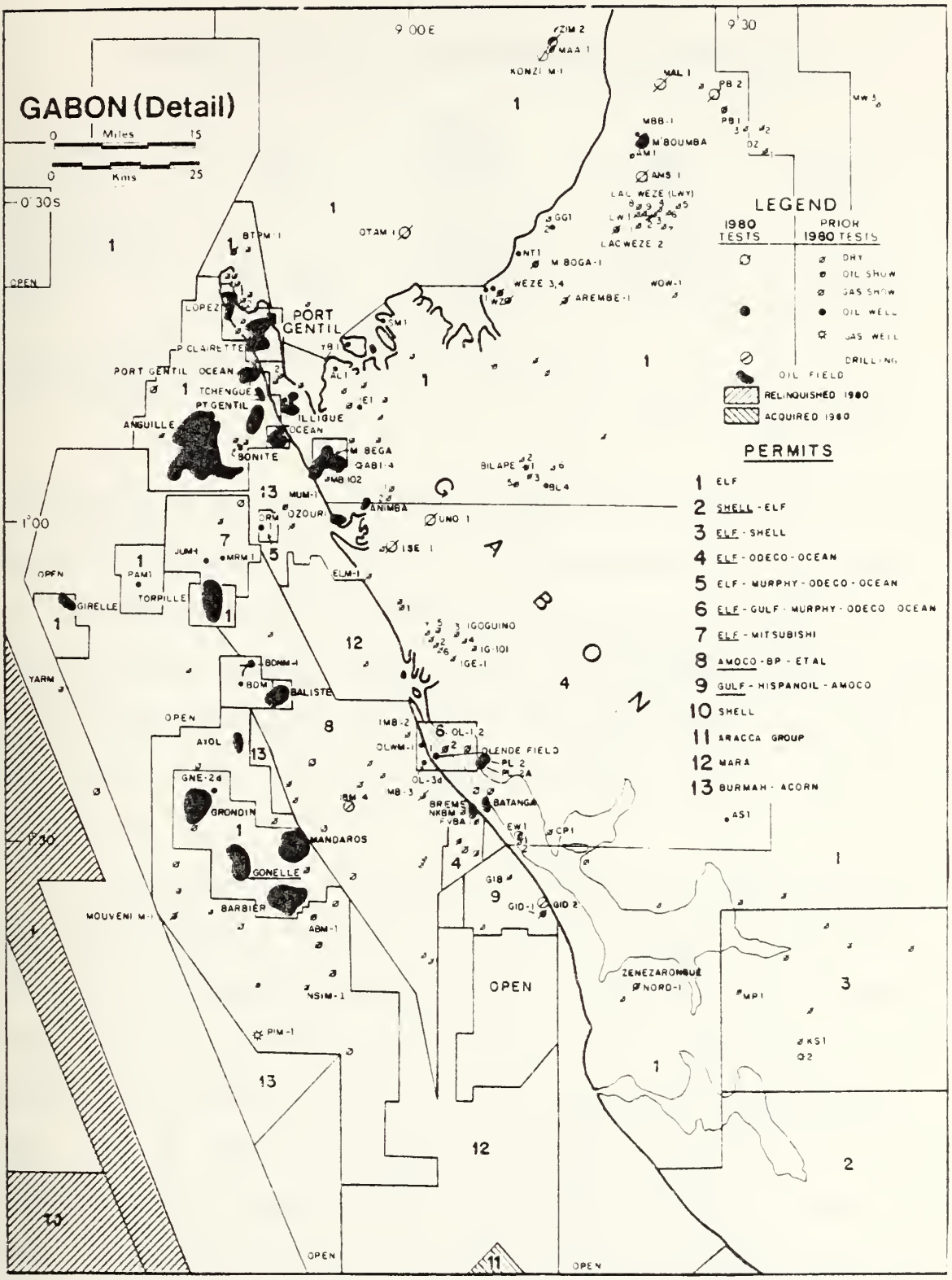

Figure 9. Gabon: Detail of concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2110]

Table 4

GABON: CRUDE OIL PRODUCTION, 1980 AND 1981

COMPANY	1980	1st 9 months 1981	Sept 1981	1981**
Elf-Gabon		125,103	130,983	
Shell-Gabon		23,956	28,100	
Totals*	176,453	149,059	159,083	149,970

*b/d converted from tons at 7.24 b/t.
**projection

[Ref. 6: p. 64]

a significant amount associated with oil production was flared owing to the lack of collecting and processing facilities. The government recently initiated a program to study the feasibility of exploiting the gas for increased domestic use. If the plan materializes it will have the added advantage of exploiting closed wells no longer producing oil. [Ref. 9: p. 27]

An extensive exploration campaign has been mounted to enlarge Gabon's dwindling crude oil reserves. In 1980, a total of 26 companies participated in exploration in Gabon. There were 20 exploratory drillings, for a total of 37,453 meters, and three of these yielded commercial discoveries. [Ref. 31: p. 1601] Exploration emphasis is being placed on inland onshore areas and the unexplored waters off the south coast. The major thrust is by Elf, who is working two rigs onshore and three units offshore. [Ref. 15: p. 59] Elf

spent more than 30 billion francs in 1980 and says it is determined to keep its exploration efforts at a high level. [Ref. 32: p. 3] The intensive exploration efforts are beginning to pay-off; in 1980, Elf discovered a field at Moubena that is expected to produce 26,000 b/d; and Standard Oil of Indiana's (AMOCO) wildcat, 35 miles southeast of Port Gentil, struck what resident manager Trump calls "a beauty of a find," actually a 2,100 b/d well that flowed twice as much under test. [Ref. 9: p. 27; 16: p. 55] As of January 1982, there were 15 active rigs in Gabon, three more than in the previous year. [Ref. 13: p. 178]

3. Reserves and Potential

Gabon has parts or all of four sedimentary basins within its territorial limits that have known oil or gas potential. The Congo and Congo Fan Basins in Gabon's southern offshore area were described in the discussion of Angola. The Douala Basin in the northern offshore region was described in the section on Cameroon. Currently, Gabon's production comes from the Gabon Basin, which is actually a continuation of the Douala and Congo Basins, and occupies both the on and offshore central three-quarters of the Gabonese coastline. Oil shows are present in almost every stratigraphic unit in the basin and much of it remains to be explored.

Gabon's crude oil reserves fell slightly in 1981 to 480 million bbl, while natural gas reserves gained modestly to 490 billion cu. ft. [Ref. 12: p. 85] Gabon does not have

the vast proved reserves of its West and North African neighbors, and some experts believe that while recent finds have postponed the day of reckoning to some extent, barring new discoveries, time is running out and production will decline gradually over the next decade to a negligible amount in the 1990's. They maintain that the best Gabon can hope for, given current proved reserves, is to stabilize output at between 160,000 and 180,000 b/d. [Ref. 15: p. 58]

On the optimistic side, other sources, which include Gabon's Minister of Mines and Oil, claim that recent discoveries have doubled Gabon's known oil reserves. It would seem that with new fields like Baliste coming on stream with recoverable reserves of 15 million bbl, the trend is becoming more favorable. [Ref. 29: p. 3438; 20: p. 196] In fact, there are two major factors that favor a resurgence of Gabonese reserves: the country still has large unexplored onshore and offshore areas with known oil and gas potential, and the government's new interest in exploiting gas will undoubtedly stimulate an increase in natural gas reserves. This argument is both intuitively and empirically correct, but it must overcome some difficult obstacles to become manifest. Foremost, is that while promising structures have been uncovered during recent explorations, because of the complexity of Gabon's geological formations and its hostile operating environment, development will necessitate large investments and the latest technology to succeed.

E. GHANA

1. General

Significant deposits of oil were first discovered in Ghana in 1970 by a consortium called Agri-Petco of Ghana, led by the U.S. based Signal Oil Group. The find, located approximately eight miles offshore south of Saltpond, went into production in 1978 with six wells producing around 5,000 b/d. Development of the small field was delayed because of changing government policies and low crude oil prices. [Ref. 33: p. 5345; 15: p. 65]

Political and economic instability have been major constraints to oil development in Ghana, and the future seems to promise more of the same. The government, which announced that it would establish a state owned oil company by mid-1982, currently has the right to participate in petroleum production and exploration by taking an interest of up to 20 percent. [Ref. 34: p. 452] In 1981, under the now deposed Limann Administration, a ten member Petroleum Promotion Council was inaugurated to coordinate and encourage exploration efforts in the country. [Ref. 9: p. 29] The Administration's Minister of Fuel and Power, Mr. F. Wulf-Tagoe, said his Ministry would "... maintain a fair and favorable climate for all companies operating in Ghana." His chief concern was for Ghana to achieve oil self-sufficiency to escape from a $40 million per month oil import bill. [Ref. 35: p. 135] However, the new Rawlings-led government has taken the

petroleum legislation and policies of the Limann Administration under advisement, and while the new government has not announced its position on petroleum resources development, the probability for change would seem to be moderately high. In addition, since further political instability seems probable, some U.S. petroleum analysts regard post-coup Ghana as potentially the most hazardous country in West Africa for oil company operations and for the physical safety of oil company employees.

2. Production and Exploration

Agri-Petco's operations at the Saltpond field have been plagued with technical difficulties caused by rising gas-oil ratios and three of the six wells were taken off production in 1980 (see Fig. 10). Output has fallen to a modest but steady 2,100 b/d -- making Ghana the smallest producer in West Africa. [Ref. 15: p. 65]

The government announced in 1981 that oil exploration is to be extended to onshore and inland sites as well as some lagoons. [Ref. 35: p. 135] The Phillips' discovery in the Ivory Coast has renewed exploration interest in Ghana's portion of the Ivory Coast-Ghana Basin, and the largest effort in Ghana is being led by Phillips. The company, with an interesting offshore oil and gas discovery near Half Hassini, has spent $60 million and plans to spend another $10 million. [Ref. 36: p. 3407] Texas Pacific has been exploring the lagoon area near Keta, and the Brazilian government was

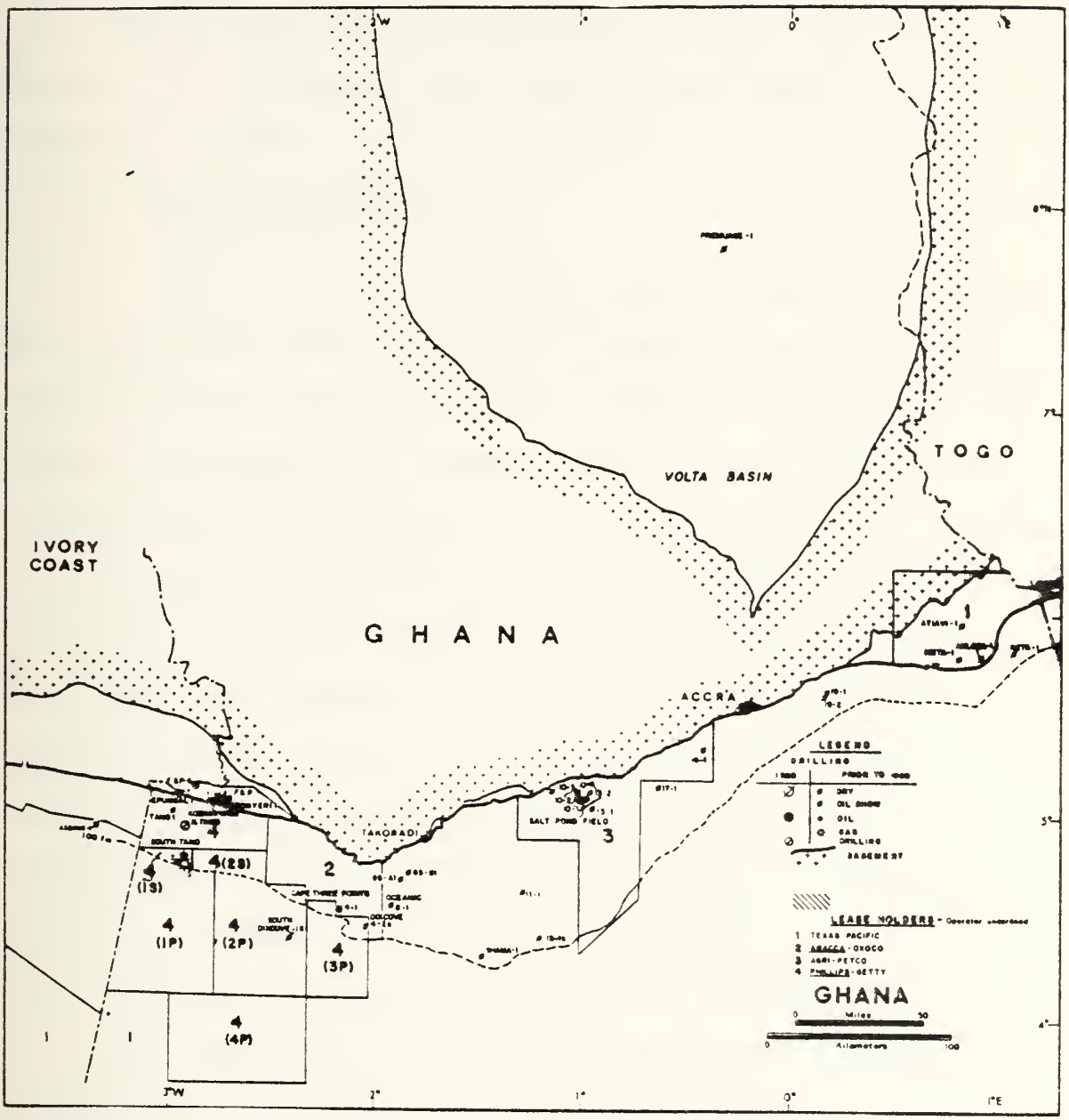

Figure 10. Ghana: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2112]

negotiating an exploration agreement. [Ref. 35: p. 135] In 1980, only two wildcats were drilled, one was declared oil producing and one gas producing. [Ref. 20: p. 193] However, as of January 1982, there were no active rigs reported in Ghana. [Ref. 13: p. 178]

3. Reserves and Potential

Ghana has access to four major sedimentary basins: The Ivory Coast-Ghana Basin is discussed under the Ivory Coast, and the offshore Niger Cone Basin is thought to have limited potential. The Dahomey Basin is part of the great coastal basin which extends from the Ivory Coast to Nigeria. It is largely unexplored, but is structurally similar to the Ivory Coast-Ghana Basin and it has produced oil discoveries. The inland Volta Basin, lying along Ghana's eastern border, has had limited exploration; traces of oil and gas have been found, indicating that the area has some interesting prospects. [Ref. 22: pp. 14-16; 42-51] Ghana's proved oil reserves stand at 6.3 million bbl, and although gas is present, reserves have not been established. [Ref. 9: p. 29] Even with an extensive exploration campaign to locate larger deposits, it appears that Ghana will have to struggle to merely achieve partial self-sufficiency in the near future.

F. IVORY COAST

1. General

Petroleum exploration started in the Ivory Coast in 1971, and although several small finds were made in the mid-1970's, due to low crude oil prices, they weren't considered commercially feasible. In 1975, a group led by Esso Côte d'Ivorie and Esso AG discovered the Grand Belier field in the country's central offshore area. In 1978, Esso decided to put the field on production and by 1981, with development still in progress, output had reached 7,000 b/d. [Ref. 15: pp. 65, 67; 12: p. 85] However, the most significant event in Ivorian petroleum history occurred in 1980 when a Phillips Petroleum led group discovered what appears to be the first field of giant size (over 500 million bbl) west of the Niger Delta. [Ref. 15: p. 68] Neither Phillips, nor the Ivorian government will talk about the field's reserves or potential production rate, but other industry sources seem to think the find could boost the Ivory Coast into second place among West African producers. [Ref. 6: p. 52]

According to a recent study by the Ivorian government, the country will soon be self-sufficient in oil, and is well on its way to becoming a net oil exporting country. [Ref. 37: p. 2947] That is good news for a country facing a serious financial crisis from a rapidly growing external debt. The country is projected to become self-sufficient in 1983, and oil revenues should become a major foreign exchange earner by mid-decade. [Ref. 38: p. 5]

In 1975, the Ivory Coast followed the pattern set by other oil producing states by forming the Societé D'Operations Petrolières De Côte D'Ivoire (PETROCI) to act for the State and public on all matters concerning oil and gas development. By law, PETROCI can take up to a 60 percent equity share of any petroleum concession in the country, and collect a 50 percent tax on net profits and royalties. Each concession is negotiated and controlled separately through a series of production-sharing contracts. When the contract for the Grand Belier field was negotiated, the two Exxon subsidiaries were given a 63.75 percent share, Shell Côte d'Ivorie 21.25 percent, and PETROCI took the remaining 15 percent. PETROCI took a more sophisticated approach when it negotiated the contract for the Espoir concession. The nominal equity split was Phillips 57.5 percent, Agip Africa Ltd. 22.5 percent, Sedco of the Ivory Coast Inc. 10 percent, and PETROCI 10 percent; however, PETROCI reserved its option to increase its interest as production rises, at the expense of the other participants. [Ref. 15: pp. 67-68; 39: p. 7]

2. Production and Exploration

In an effort to turn a trickle of oil into a torrent, development is underway at a furious pace in the Ivory Coast. With nine wells producing, Esso's Grand Belier field increased its output by 600 percent in its first two years of production and was expected to reach 20,000 b/d in 1983 (see Fig. 11). [Ref. 9: p. 31] But in 1981, the field began having

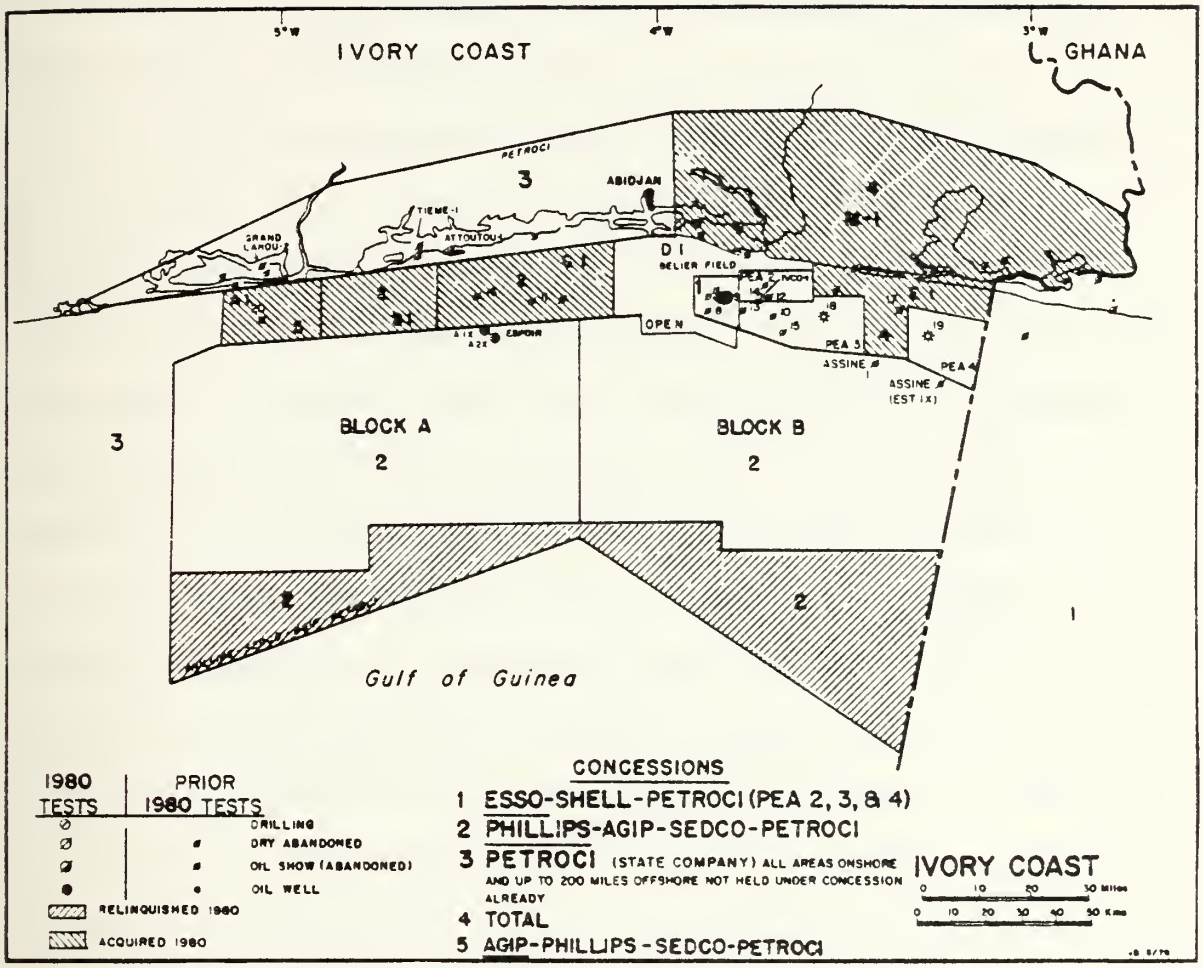

Figure 11. Ivory Coast: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2113]

production problems and the Esso-Shell group is installing a gas and water injection system to boost output. [Ref. 16: p. 56] Esso now believes that peak output will be around 11,000 b/d -- 36.6 percent of Ivorian domestic petroleum consumption. [Ref. 40: p. 21]

Phillips completed its first Espoir field producer in December 1980, at a flow rate of 6,335 b/d oil and 2.3 million cfd gas; five other wells had been drilled as of December 1981, four found gas and/or oil. [Ref. 41: p. 34] The group is running four rigs, contracted for five more, and Phillips has ordered equipment for extended Espoir production. Development plans call for drilling 30 more wells at a cost of $12 million each, but with water depths of up to 2,400 feet and a steeply inclined seabed, the field will require an abnormally high number of production platforms, which will delay the full development of Espoir. [Ref. 16: p. 56; 40: p. 34] The discovery well is believed capable of producing up to 20,000 b/d and the field's output could reach 200,000 b/d by the mid-1980s, and possibly 400,000 b/d by 1990. [Ref. 42: p. 6; 15: p. 68]

Production from Esso's Belier and Phillips' Espoir fields has created a flurry of exploration activity. Four new exploration permits were granted between March and November 1980 alone. Elf Aquitaine and CFP-Total of France have started exploring the Ivory Coast again with three separate concessions. [Ref. 9: p. 31] Agip and partners,

Union Texas and Total, have taken a concession south of Abidjan for sea and land exploration. [Ref. 34: p. 452] In January 1982, there were six rigs working and more on the way, but there is no easy access to Ivorian oil. [Ref. 13: p. 178] Onshore deposits are widely dispersed and offshore there is deep water and irregular terrain; in both cases, exploration is an expensive proposition.

3. Reserves and Potential

The Ivory Coast has only one sedimentary basin with hydrocarbon potential, the Ivory Coast-Ghana Basin, which extends along the shoreline from southeast Liberia to central Ghana. Seismic data indicate that the area is extensively faulted and that tilted fault block structures are common throughout the area. Fractures in the high quality reservoir rocks, associated with graben fill and coarse-grained sedimentary rock, have acted as a funneling mechanism for hydrocarbons. [Ref. 22: p. 42-51] The area's greatest potential is believed to be offshore in deeper waters, which remain largely unexplored.

The Ivory Coast has been a bitter lesson for Elf Aquitaine. The company's geologists predicted that the country had little potential for producing oil, only to have Phillips turn up with a major addition to Ivorian reserves -- on a concession abandoned earlier by Elf. [Ref. 18: pp. 44-45] The country's proved oil reserves are currently estimated to be 314 million bbl, but the same sources estimate

that Espoir alone may contain 500 million bbl. [Ref. 12: p. 85; 15: p. 68]* Both Grand Belier and Espoir have large natural gas reservoirs, with estimated proved reserves of 37 billion cu. ft. [Ref. 12: p. 85] This is considered to be a conservative estimate since there has been no incentive to prove up gas reserves. In addition to conventional oil and gas deposits, the Ivory Coast also has estimated oil shale reserves of 3.5 billion bbl. [Ref. 43: pp. 38-39]

If oil prices were to stabilize at $32 per bbl or higher, and with as much as $4 billion programmed for oil development investment in the next five years, the potential for additional commercially exploitable discoveries is high. [Ref. 42: p. 6] Jean-Yves Baudoin, of Chase Manhattan Bank's Abidjan office, maintains that 500,000 b/d is not an overly optimistic figure for Ivorian output in the next five or six years; and the bank is backing its opinion with a $275 million loan to tide the Ivory Coast over until the oil flows. [Ref. 16: p. 63]

G. NIGERIA

1. General

Nigeria is the "Saudi Arabia" of West Africa, literally dwarfing all other West African oil producers.

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*The Phillips group is still attempting to define the limits of its Espoir find. Until that is completed, any estimates of the field's reserves will be highly speculative.

Total West African crude oil production was reported at approximately 2.7 million b/d in early 1981, of which over 52 percent came from Nigerian wells. [Ref. 44: pp. 40-42] In fact, one operating company, Shell Development of Nigeria, outproduced all of Black Africa's remaining oil producers combined.

Nigeria's association with oil began in 1908 when oil seepages motivated a German-owned company to conduct an unproductive search in the Lagos area. Exploration activity was resumed in 1937 by Shell Oil Company. However, it was 1956 before Shell, in partnership with British Petroleum, made Nigeria's first commercial oil find in the swamps near Oloibiri. The discovery opened the Niger Delta area, where Shell's production started at 6,000 b/d in 1958 and had climbed to a capacity of 1.4 million b/d in 1981. [Ref. 9: p. 60; 15: p. 52] Nigeria's other major operating companies are Gulf, Mobil, Agip, and Elf, while those with smaller holdings include Ashland, Pan Ocean, Texaco/Chevron, Tenneco, Phillips, and Sunray (see Fig. 12). [Ref. 45: p. 48] Annual average economic growth has been twice as fast in Nigeria since oil revenues began escalating in 1967. With crude oil exports of approximately two million b/d, in 1980 oil revenues earned 94 percent of Nigeria's foreign exchange and accounted for over 80 percent of all federally collected revenues. [Ref. 21: p. 86; 46: p. 425]

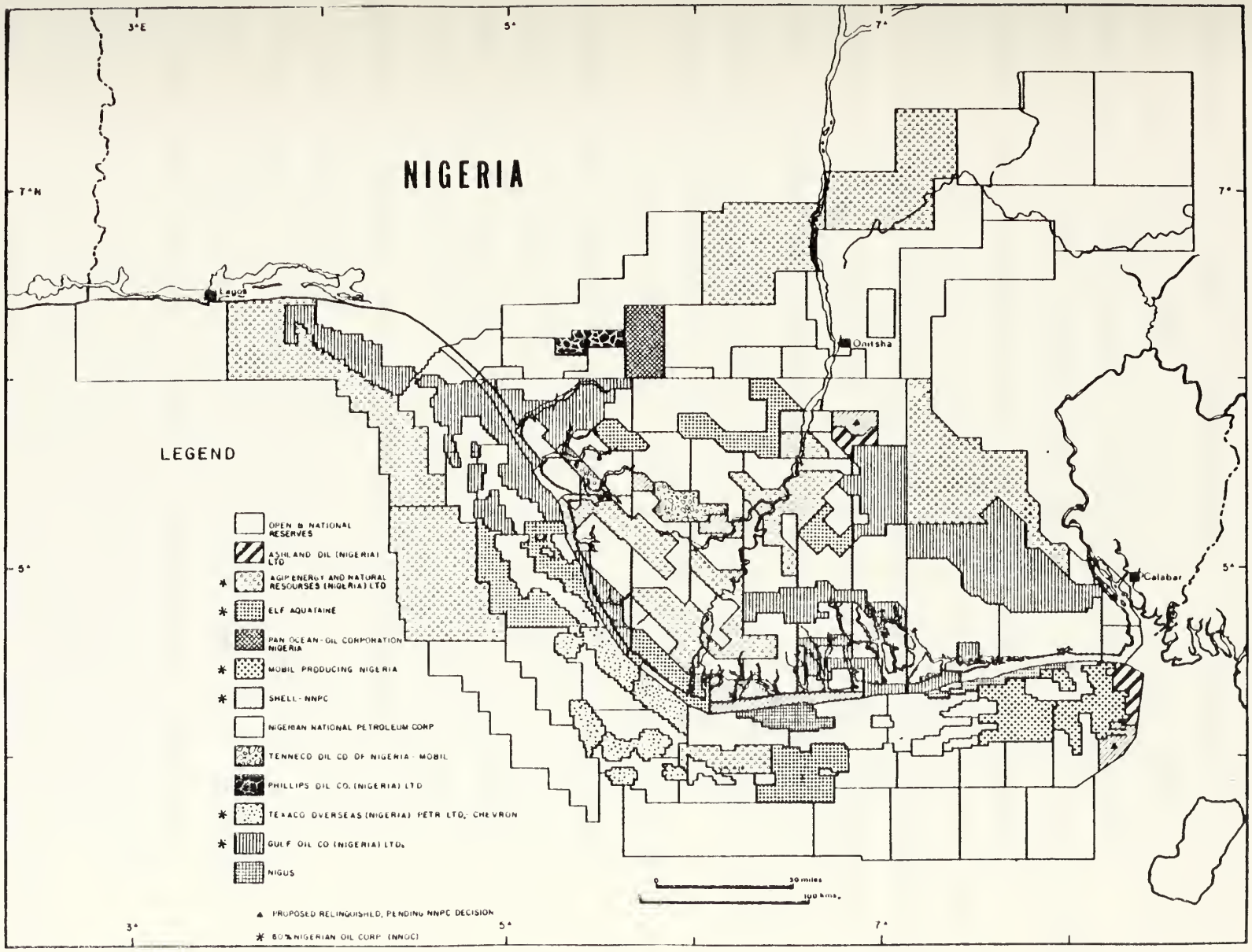

Figure 12. Southern Nigeria: exploration rights. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2122]

Nigeria, a member of OPEC since 1971, has had the most restrictive petroleum policies toward foreign oil companies of any West African nation. The Nigerian National Petroleum Company (NNPC) was formed in 1977 by combining the functions of the Ministry of Petroleum and the Nigerian National Petroleum Company, and as such, NNPC has much broader powers than most other state oil companies. NNPC has a 60 percent equity share in all the foreign oil companies except for Shell/NNPC, which, owing to the nationalization of Shell's partner British Petroleum in 1979, is 80 percent government held. Present government relations with foreign operating companies are clouded by questions of company incentives and political uncertainty. [Ref. 9: p. 58]

In late 1979, NNPC was the subject of a government scandal that hampered the organization's decision-making process, virtually paralyzing all key decisions concerning long term projects with the international oil companies. Between politics and economics, it now appears that long awaited projects, such as the Bonny LNG complex, will be delayed indefinitely. [Ref. 16: p. 55] Another major problem area is the declining level of incentives for foreign oil companies to invest more capital, or in some cases, to even continue their Nigerian operations. Problems of this nature include: NNPC's initiation of "Risk Service Contracts" which offer new foreign companies no equity interest in future production, government imposed production

ceilings, and unattractive profit margins. To illustrate the severity of the situation, in 1977 foreign oil companies were allowed a profit of $.84 on each barrel of oil, since then official Nigerian oil prices have increased 177 percent, but company profit margins remained at $.84 per barrel until August 1982. In the Shell/NNPC case, the split of revenue on all production was a ratio of 200:1 in favor of the government. [Ref. 15: p. 50; 47: p. 2]

In August 1982, the NNPC increased the allowable profit margin of the oil companies to $1.60 per barrel. The new profit policy has provided enough incentive to encourage the development of existing leases, but it has not been enough, under current market conditions, to interest the oil companies to move into the deep water offshore areas that Nigeria needs to develop. Although these problems are by no means unique to Nigeria, when Nigeria's policies toward the oil companies are combined with declining crude oil prices, the result has been a reluctance by the oil companies to gamble on leases in unproven frontier regions.

2. Production and Exploration

According to the Petroleum Economist, Nigeria suffered a massive crude oil production slump of 33.2 percent in 1981. With 142 fields on stream, Nigeria produced 498,400,000 bbl in 1981, compared to the 1980 output of 745,827,500 bbl. [Ref. 6: p. 67] The 1981 drop in world demand for crude oil, combined with Nigeria's refusal to

adapt its pricing policies to changing market conditions, precipitated the production nose-dive, which was Nigeria's lowest output in ten years. Natural gas production was approximately 865 billion cu. ft., of which 35.3 billion cu. ft. was consumed domestically -- the remaining 829.9 billion cu. ft. were flared. [Ref. 9: p. 64]

Many of Nigeria's fields produce less than 10,000 b/d, and anything over 20,000 b/d is considered a big field. Nigeria's largest operator, Shell, had 78 fields on stream in 1980, ranging from the 300 b/d Oza field to Forcados Yorki, the only field currently producing over 100,000 b/d (See Fig. 13). Mobil is developing its Oso field, which may become Nigeria's second 100,000 b/d field in 1983. [Ref. 15: pp. 50-53] In another development, Texaco is planning to boost Nigerian productive capacity by another 100,000 b/d when its three new fields come on stream in late 1982. [Ref. 20: p. 193] While Gulf, Nigeria's second largest operator, is developing a new offshore field expected to flow at 25,000 b/d. [Ref. 9: p. 60] Nigeria's crude oil output since 1976 is shown in Table 5.

Nigeria, where 45 percent of all wildcats strike oil, is still the hub of exploration activity in West Africa. But, Nigeria is not an easy country to work in, reservoirs are generally small and many are in the difficult Niger Delta swamp. Yet, exploration activity is very high, both

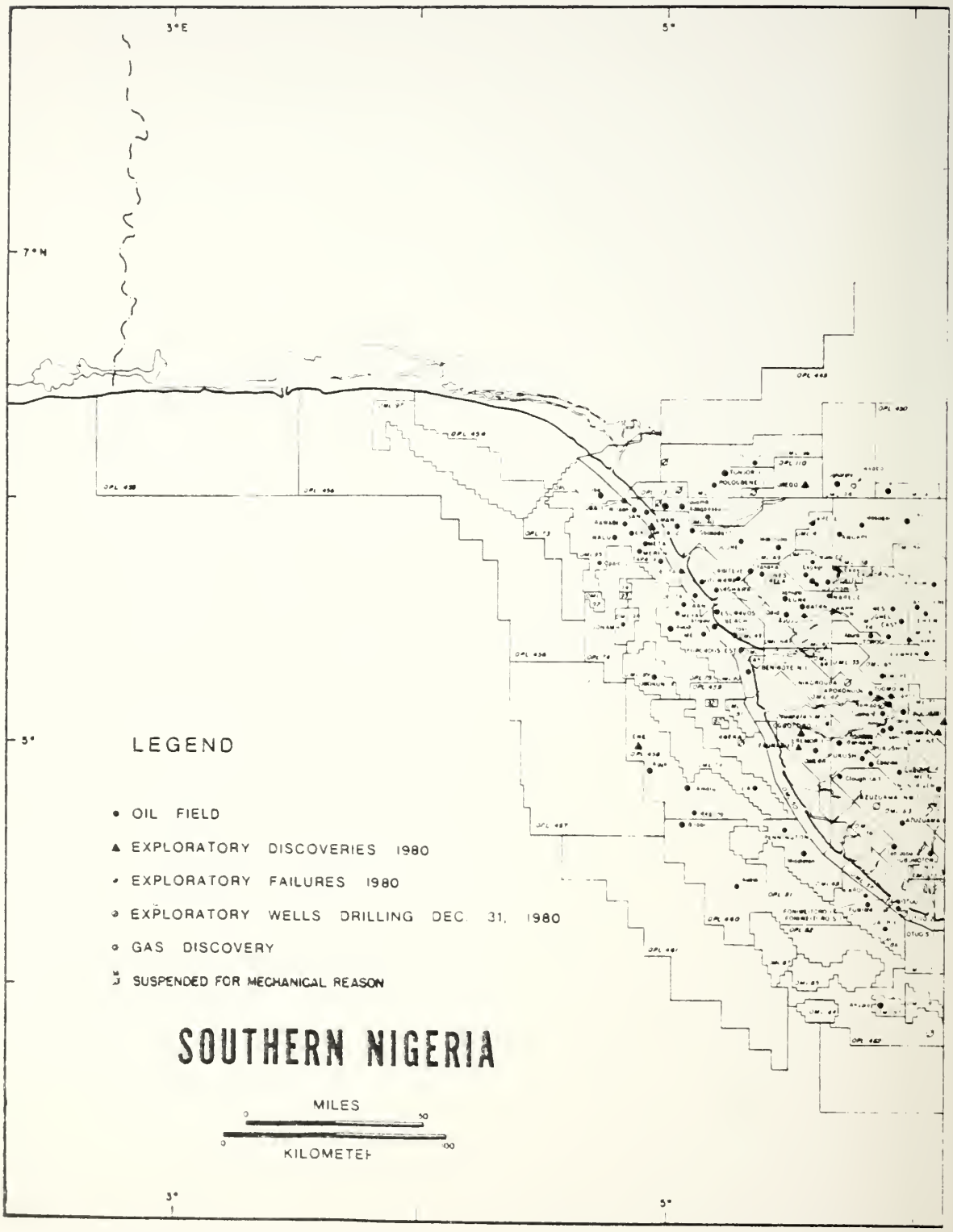

Figure 13. Southern Nigeria: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: pp. 2120-2121]

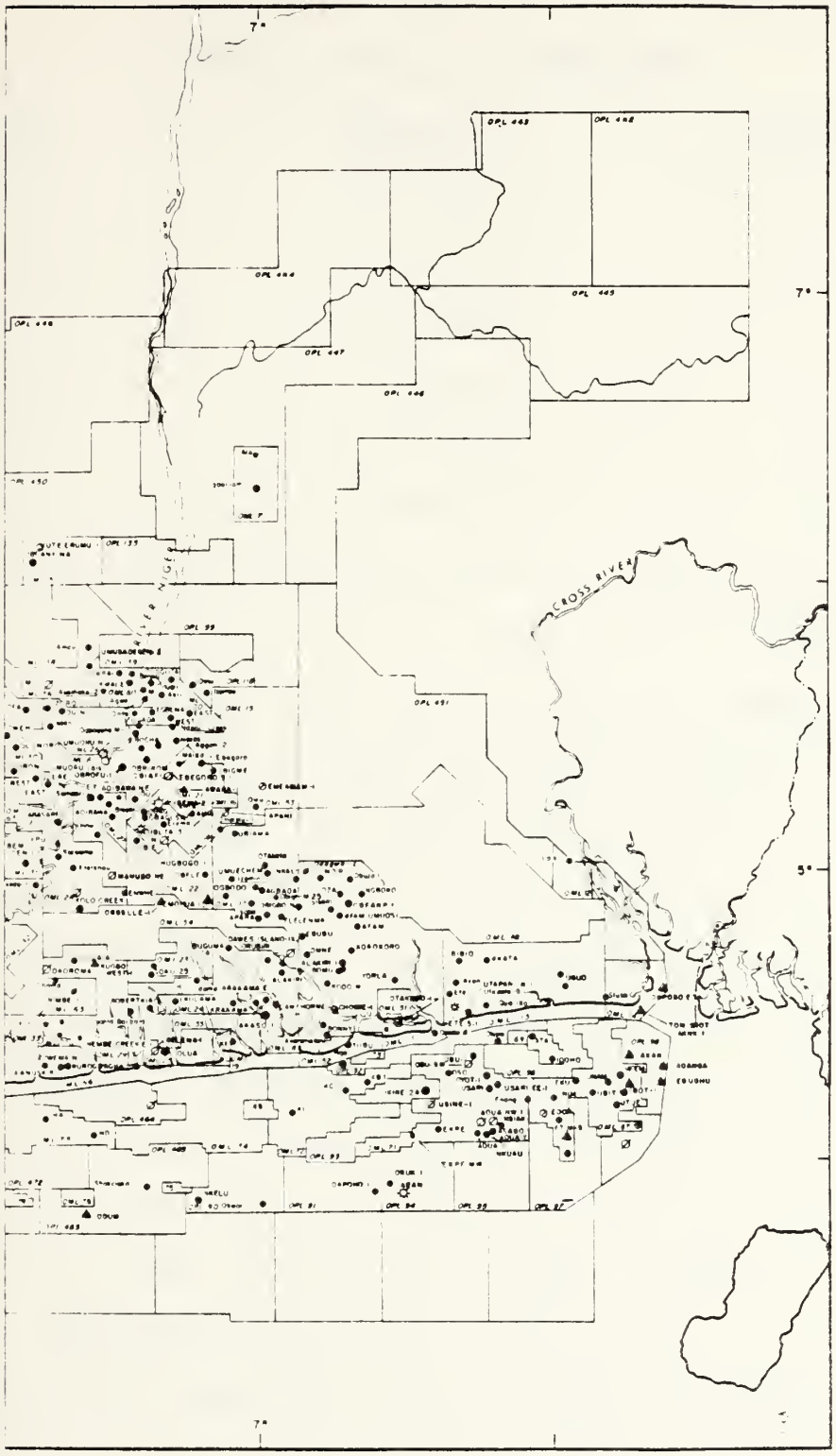
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Table 5

NIGERIAN CRUDE OIL PRODUCTION

YEAR	OUTPUT b/d	% GAIN/LOSS*
1976	2,078,085	
1977	2,067,843	-.5
1978	1,902,988	-7.9
1979	2,299,410	+20.8
1980	2,038,804	-11.3
1981	1,365,479	-33.2

*Computations based on previous year's production.

[Ref. 9: p. 63; 6: p. 67]

in the swamp areas and the relatively friendly offshore and inland regions. The June 1981 active rig count of 20 onshore and five offshore rigs, had climbed to a total of 28 working rigs in January 1982. [Ref. 9: p. 61; 13: p. 178]

Although Nigeria's annual discovery of new reserves, since 1979, has significantly exceeded its annual depletion rate, the Nigerian government has been anxious to keep exploration at a high level. President Shagari announced that $1.829 billion would be spent in Nigeria for oil exploration in 1981, and NNPC has offered virtually all of Nigeria's unallocated acreage for exploration -- albeit at such unattractive terms that only one private firm took on

new acreage. [Ref. 48: p. 5; 15: p. 50] Despite the long list of negative incentives levied both by the Nigerian government and the hostile operating environment, private interest in exploration has remained relatively intensive. Shell, who is operating four land rigs, three swamp rigs, and one offshore rig, decided in 1981 to begin development of their first offshore discovery and they hope to add more rigs. [Ref. 15: p. 52; 23: p. 193] Gulf has mounted an aggressive campaign aimed at raising its output capacity to 500,000 b/d by 1984-85, and based on past performance there is every reason to believe the company will attain its goal. [Ref. 45: p. 48] Texaco had set aside $150 million to drill 27 new wells in 1981, in an effort to bring its production capacity to 130,000 b/d -- double its present capacity. [Ref. 16: p. 55] Both Agip and Mobil had major discoveries in 1981; Mobil's find reportedly has recoverable reserves of a billion barrels. [Ref. 49: p. 14] And Elf, which accounts for only five percent of Nigeria's production, but for 20 percent of the country's total exploration expenditures, is intent on doubling its share of Nigeria's production capacity by 1985. [Ref. 6: p. 57; 18: pp. 44-45] Each company's share of Nigeria's 1981 crude oil output is shown in Table 6.

3. Reserves and Potential

Nigeria has access to six sedimentary basins, of which five are known to have hydrocarbon potential. Nigeria's current production and a preponderance of its exploration

Table 6

NIGERIA'S 1981 CRUDE OIL PRODUCTION

FOREIGN COMPANY	OUTPUT*	PERCENT
Phillips	1.1	.08
Mobil, Tenn, Sun	5.7	.4
Pan Ocean	7.3	.5
Ashland	9.6	.7
Texaco	36.7	2.7
Elf	71.3	5.2
Agip	139.6	10.2
Mobil	159.2	11.6
Gulf	287.3	20.9
Shell	655.3	47.7

*,000 b/d

[Ref. 50: p. 2950]

activities are centered in the Niger Delta Basin which is very similar to the Mississippi Delta in the U.S. Oil and/or natural gas have been found in the Anambra, Dahomey, Benue, and Niger-Chad Basins, but their true potential remains to be determined. The Niger Cone, lying offshore in deep water, is believed to have limited potential. [Ref. 22: pp. 16-28, 52-58; 51: p. 334] When the government opened portions of the Niger-Chad, Benue, and Anambra areas to exploration, there was a great deal of geological interest expressed, but very little action taken due to the onerous nature of the attendant contracts. [Ref. 15: p. 50]

Estimates of Nigeria's crude oil reserves range from 16.5 to 20 billion bbl. [Ref. 12: p. 87; 16: p. 55] If market conditions are favorable, it is estimated that production could go as high as 2.4 million b/d in 1985. [Ref. 44: pp. 40-42] Higher levels of production would

require the discovery and development of new reserves. Estimates that output can continue at around 2.0 million b/d only until the end of the century may have been tempered by recent discoveries, such as the Mobil and Agip finds, which suggest that large amounts of oil remain to be found in Nigeria. According to two of Texaco's top officials, Nigeria is "...one of the best oil provinces in the world and the potential is unlimited ...the real question is incentives from the government." [Ref. 16: pp. 53-55]

However, some experts are predicting that in the long term, natural gas will take over as Nigeria's principle source of foreign exchange. Currently, eight Sub-Saharan countries have proved natural gas reserves; approximately 87 percent of these are located in Nigeria. [Ref. 37: p. 2947] Nigeria's proved gas reserves are estimated at around 41 trillion cu. ft. and 80 to 85 percent is nonassociated gas. [Ref. 15: p. 61] The general consensus is that this is an extremely conservative estimate, and that more reserves would be quickly generated if Nigeria could get its LNG project underway again. The Bonny LNG complex was planned to have a capacity of 1.9 billion cfd, with a start up cost of approximately $15 billion. One industry source claims that there may be enough natural gas potential in Nigeria to support several LNG projects the size of Bonny. [Ref. 15: pp. 60-61]

When support for the Bonny LNG project began to collapse, the Bechtel Corporation attempted to interest the Nigerian government in the development of a trans-Saharan pipeline, which would have delivered Nigeria's natural gas to Western European markets and avoided many of the expensive technical problems associated with LNG. However, since the pipeline was to cross Algeria, the proposal was rejected by Nigeria for political reasons. Consequently, international consumption of Nigerian natural gas remains dependent upon the development of a Nigerian LNG capability -- a prospect that remains out of the question until the NNPG regains more political stability, the necessary financial backing is found, and the international demand for LNG increases substantially.

H. ZAIRE

1. General

The former Belgian Colony of Zaire became Africa's tenth oil producing country in 1975, when Gulf Oil began producing crude oil from two small offshore fields in the mouth of the Zaire River. [Ref. 9: p. 82] A Gulf-led group, owned 50 percent by Gulf, 32 percent by the Japanese Teikoku Oil Company, and 18 percent by the Zairian Soliza Oil Company, has been Zaire's main operator with its three small offshore fields. [Ref. 52: p. 6] In April 1980, Amoco, Belgium's Petrofina, and Royal Dutch Shell, began trial production of a new onshore field located near the Zaire River. [Ref. 53: p. 25]

In 1979, Zaire exported 6.74 million bbl of the 7.56 million bbl of crude oil that it produced. Zaire's refinery is not equipped to process Zairian crude oil, which has a high salt content, and as a result, in 1979 Zaire imported a total of 6.99 million bbl of crude oil and refined petroleum products. [Ref. 9: pp. 82-83] Consequently, petroleum does not rank very high on Zaire's list of export earners, but considering the country's disastrously high external debt, any source of constant cash flow must be viewed as a vital asset -- not to mention the benefits reaped from oil self-sufficiency.

In 1981, Zaire decided to renegotiate its existing contracts with the foreign operating companies, and in January 1982, Zaire's state owned Petro-Zaire increased its holdings in Gulf-Zaire from 15 percent to 20 percent. Under this agreement, Zaire's share of production was increased from 49 percent to 76 percent, raising government revenues from $60 million in 1981 to an estimated $160 million in 1982. [Ref. 52: p. 6] Zaire is maneuvering to gain more control over its crude oil production, both to maximize government revenues and to ensure that the state owned SOZIR refinery, with its new salt removal plant, receives adequate supplies of Zaire's domestic production to operate at full capacity. [Ref. 54: p. 24]

2. Production and Exploration

The bulk of Zaire's crude oil production comes from Gulf's three shallow water fields, GCO, Mibale, and Mwanbe, located in the narrow 25-mile strip of water on the Zaire River estuary (see Fig. 14). Output from these small fields declined from a high of 25,122 b/d in 1976, to 17,692 in 1980; following more development work on the Mibale structure, Gulf was able to get output back up to 22,568 b/d in November 1981. [Ref. 9: p. 55: p. 91] Onshore, in the same vicinity, Amoco and Petrofina are testing their new field; output from the two test wells is 1,000 b/d to 1,200 b/d, and if production rates hold up, a sustained development program is expected to follow. [Ref. 15: p. 64] Zaire's cumulative crude oil production since 1976 and the 1981 output from each field is shown in Table 7.

Table 7

ZAIRIAN CRUDE OIL PRODUCTION

FIELD	1981*	CUMULATIVE**
GCO	1,264	4,767,766
Mibale	17,699	36,457,515
Mwambe	70	265,776
Mayombe***	1,000	
	20,033	41,491,057

*b/d average first six months, 1981
**Cumulative bbl to 1 July 1981
***Amoco/Shell onshore trial production

[Ref. 12: p. 142]

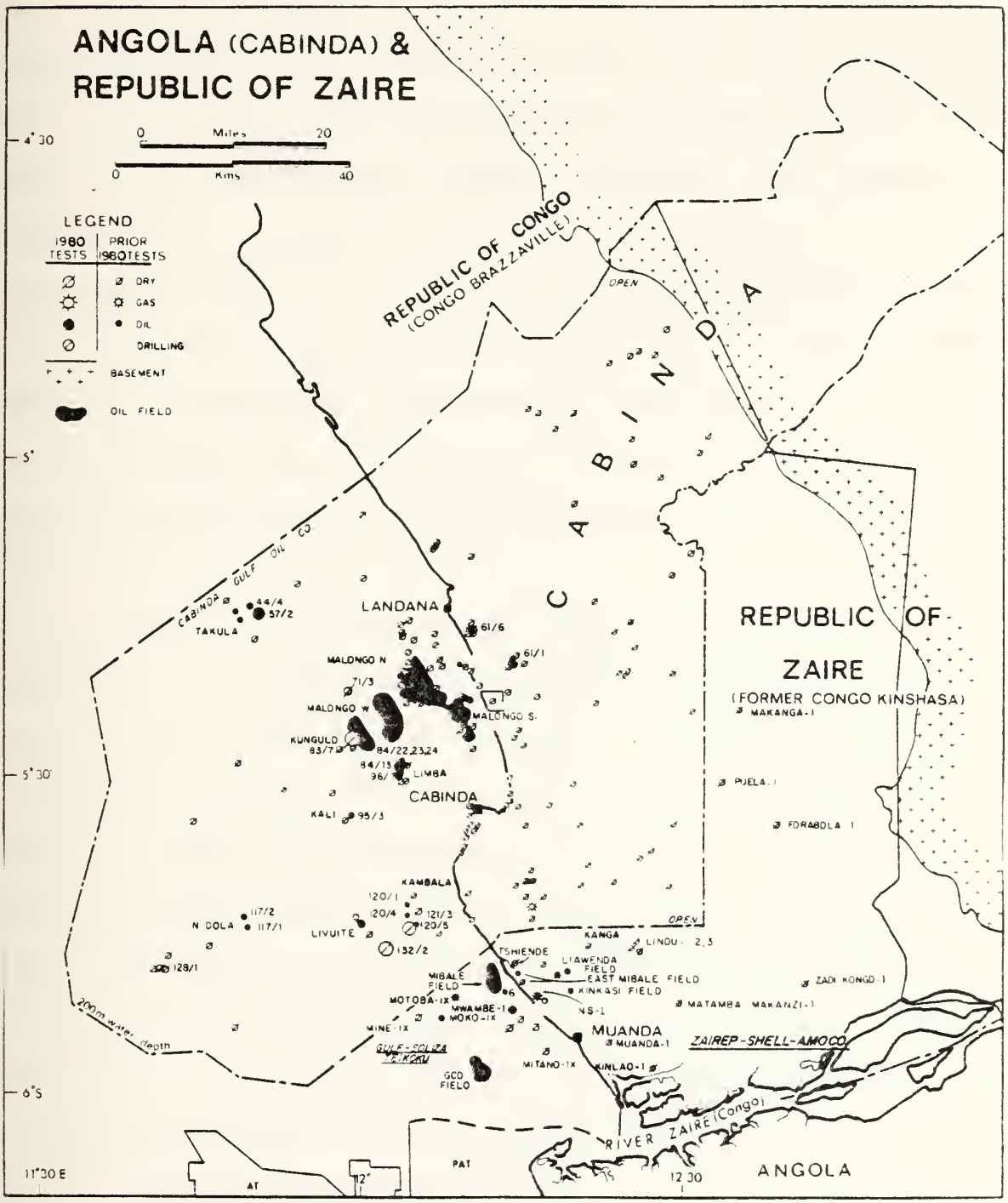

Figure 14: Angola-Cabinda and Republic of Zaire: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2090]

Although Zaire is only a small producer, interest in exploration is accelerating: the country's active rig count went from one in 1980 to three in 1981, and major oil companies involved in prospecting went from three to ten. [Ref. 13: p. 178] The most massive exploration programs are being led by American and French companies. Esso (Exxon) in partnership with Texaco is spending $40 million to drill two exploratory wells in Zaire's thick equatorial jungles (see Fig. 15). The first well near Mbandaka, in Equateur Province, yielded no evidence of hydrocarbons. The second well, in the Bandundu region, was begun in the summer of 1981, and if results are encouraging, more exploration will take place. [Ref. 16: p. 63; 56: p. 7]

Zaire's other major exploration campaign is being led by France's Elf Aquitaine in partnership with Mobil, Agip of Italy, and two Yugoslavian companies. Prospecting off the Zaire River estuary, Elf discovered oil with its first well. There has been no information on the size of the discovery, but the French company wants to drill three appraisal wells and conduct more seismic tests. Elf is reportedly anxious to locate more drilling rigs to use in exploring the find. [Ref. 57: p. 26] Gulf, Petrofina, and Amoco were also prospecting Zairian acreage for new oil.

3. Reserves and Potential

Zaire's current crude oil production comes from the Congo Basin, which lies along Zaire's coast. Zaire has two

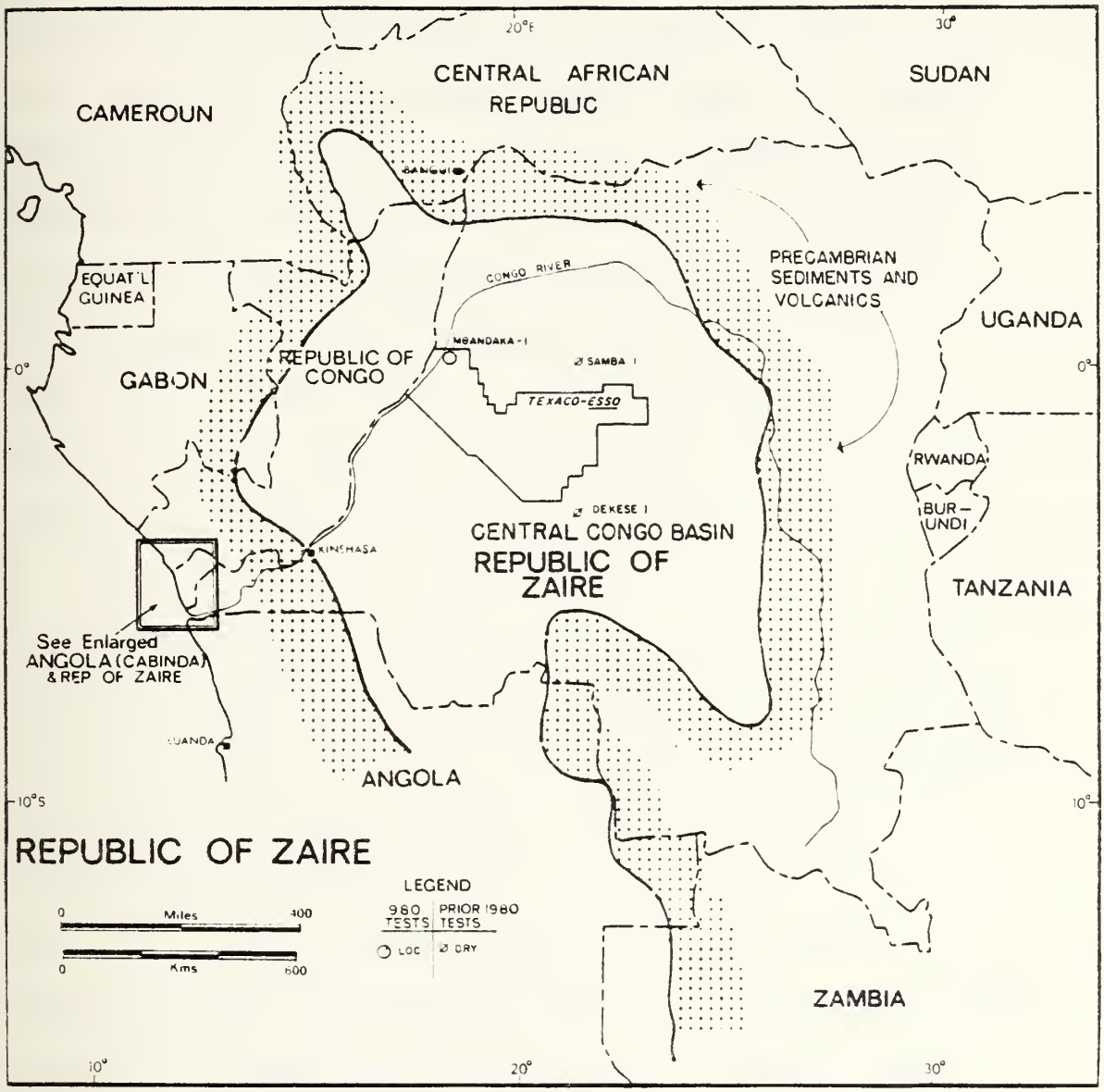

Figure 15: Republic of Zaire: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2130]

other sedimentary basins with hydrocarbon potential. The Congo Fan, which is totally offshore, was described under "Angola." The Zaire Basin is located onshore in the dense jungles of northern Bandundu and southern Equateur Provinces (see Fig. 15). Until recently the region had remained unexplored because of the tremendous expense involved, and because many oilmen had been skeptical of the region's potential. Esso and Texaco have expressed some confidence in the area with their sizeable investment, and even though their first well was dry, a Texaco spokesman has said that Zaire is one of several "...potentially promising areas where exploration could develop significant reserves." [Ref. 16: p. 63]

In January 1982, Zaire had proved crude oil reserves of 145 million bbl and natural gas reserves of 50 billion cu. ft. [Ref. 12: p. 87] In addition to its conventional oil and gas reserves, Zaire also has the World's fourth largest shale oil reserves -- an estimated 101 billion bbl. [Ref. 58: p. 83] Results from the recent surge in exploration activity have caused predictions about Zaire's hydrocarbon potential to swing decidedly to the optimistic side. Although Zaire's offshore acreage is not large, the country shares the same geological formations that have been the most productive for Angola and Congo; Zaire's inland potential remains to be seen.

III. EMERGING PETROLEUM PRODUCING COUNTRIES

A. EQUATORIAL GUINEA

1. General

Although it is surrounded by Africa's largest concentration of oil producing countries, Equatorial Guinea has only recently begun to solicit oil companies to explore its territory for oil. However, several problems have detracted from the country's efforts to achieve this goal. The first problem for the country's new government has been to determine the extent of its territorial waters so that it can grant concessions to oil companies. The rush for Equatorial Guinea's oil has brought France into conflict with Spain over exploration rights, and Spain has sent three warships into the area to defend its interests. Finally, there is an oil related border dispute brewing with Gabon. [Ref. 18: p. 44-45]

The government recently passed a new petroleum law which is based on the principle of production sharing, and it has entered into a joint venture with Spain's Hispanoil to form Empresa Guineano-Espanola de Petroleos (GEPSA). [Ref. 9: p. 31] Capital interest in GEPSA is equally divided between the government and Hispanoil. [Ref. 59: p. 149] GEPSA receives preferential treatment over other oil companies and has been given wide ranging offshore concessions.

2. Production and Exploration

The first exploration by GEPSA in its 2,000 square kilometer offshore concession revealed two potential oil zones: one in the Corisco Bay near Gabon, and the other in the continental shelf of Bilo (formerly Fernando Po) near Cameroon and Nigeria. Natural Gas is also believed to be present in the latter location (see Fig. 16). [Ref. 9: p. 31] Hispanoil-GEPSA, drilling 60 kilometers off the north coast of Biko in late December 1981, hit oil in its first well. Tests have not been completed, but the well is reported to have strong pressure. Based on reports of equipment orders, apparently development is to start immediately. [Ref. 60: p. 20] France's CFP-Total has taken an onshore concession in Rio Muni Province, and U.S. owned ARACCA Petroleum has taken the offshore rights adjacent to the Total holding. [Ref. 61: p. 1] At least five more companies have expressed an interest in obtaining concessions; three of them are U.S. companies.

3. Reserves and Potential

Geologically, Equatorial Guinea shares the same sedimentary basins and oil producing structures that support the offshore production in Nigeria, Cameroon, and Gabon. Despite the fact that it currently produces no oil, one source predicts that Equatorial Guinea could be producing at a rate of 180,000 b/d in 1986. [Ref. 21: p. 86]

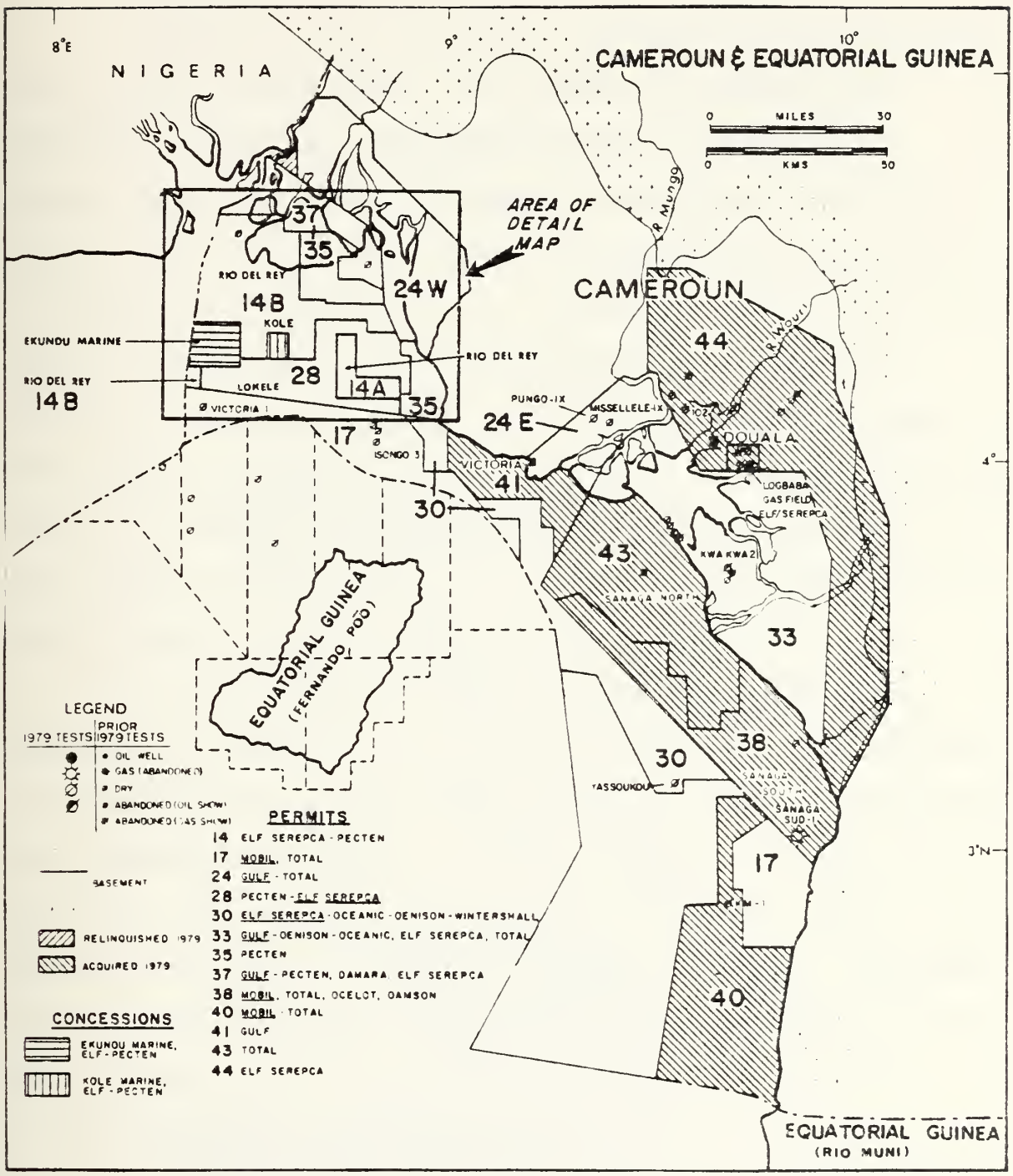

Figure 16. Cameroon and Equatorial Guinea: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 62: p. 1803]

B. SENEGAL

1. General

Senegal's first large oil deposit was discovered in 1970 by Royal Dutch Shell, 64 kilometers offshore from Casamance. However, the crude oil from the Dome Flor reservoir was too heavy to exploit commercially and Shell allowed its concession to revert to the Senegalese government in December 1979 (see Fig. 17). [Ref. 63: p. 32] With oil imports consuming 42 percent of Senegal's annual export earnings, President Senghor has given oil exploration and development top priority; but his efforts have been frustrated both by a dispute with Guinea-Bissau over the ownership of the offshore deposit and by the cost of extracting Senegal's heavy crude at current international prices.

In 1981, Senegal formed a state oil corporation, PETROSEN, to prospect for oil and to coordinate the research necessary to make the Dome Flor heavy oil deposit technically and economically feasible. Capitalized by a $470,000 World Bank loan, the company is 90 percent government owned -- the remaining 10 percent is held by Senegalese firms. PETROSEN was scheduled to become an oil development company in 1982. [Ref. 64: p. 1239; 65: p. 2]

2. Production and Exploration

In 1980, Senegal obtained a $17 million loan from the World Bank for further exploration and development appraisals of the government's concession at Dome Flor.

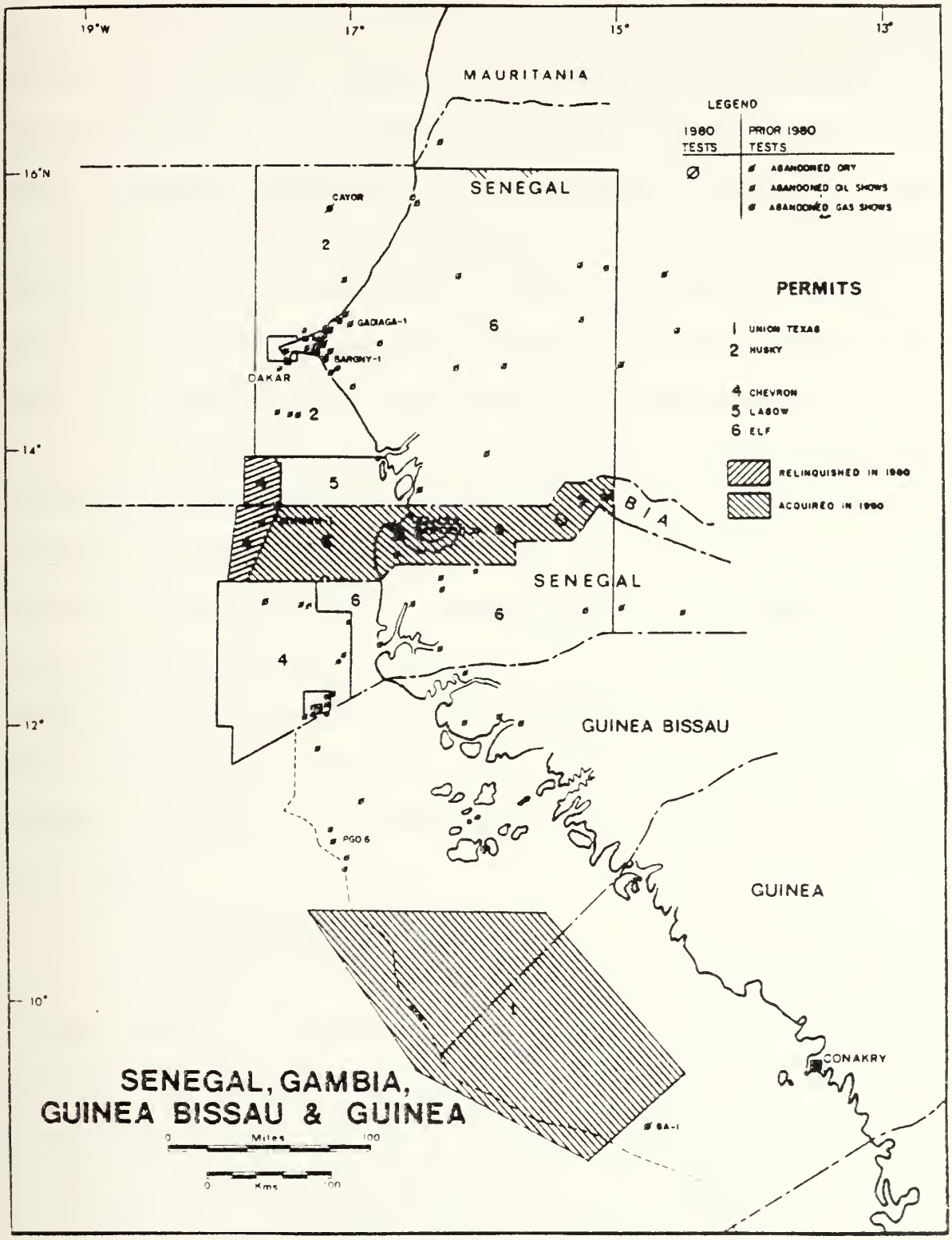

Figure 17. Senegal, Gambia, Guinea Bissau, and Guinea: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2111]

[Ref. 66: p. 22] Senegal has tentatively decided to exploit the reservoir, but the plan is plagued with problems. Rising oil prices initially made the project look better economically, but heavy crude is difficult to extract from reservoir rock and it requires expensive enhanced recovery techniques such as heating the oil in the reservoir with steam injection, or reducing the oil's viscosity by injecting carbon dioxide; the oil is also too heavy to be pumped any distance by pipeline, so it must be refined near or at the production site.

CFP-Total has discovered a small reservoir of light crude oil underlying the heavy crude at Dome Flor and production is due to start in 1983, with a projected output of 5,000 b/d for five years. According to one estimate, with the advent of favorable oil prices, production of up to 160,000 b/d of heavy crude could begin as soon as five years after development start-up. [Ref. 21: p. 86; 67: p. 26] Senegal also has some limited natural gas production offshore from Dakar.

3. Reserves and Potential

Senegal's known petroleum deposits are located in the Senegal Basin. In general, analogous type basins off the coast of North America have proved to be poor prospects for discoveries of gas and oil. Intense exploration since 1953 of the onshore and Continental Shelf has resulted in the drilling of over 80 wells. Except for the production of small amounts of oil from the Dakar Peninsula in the early

1960s and the discovery, on the shelf, of shallow heavy oil and the light oil deposits beneath, no significant discoveries of oil and gas have been made. Deep water areas of the continental shelf and upper continental rise are still relatively unexplored by drilling; but the results of sparse drilling indicates a possible lack of reservoir rock. [Ref. 22: pp. 28-36]

Crude oil reserves in the Dome Flor oil field are estimated to be 733 million bbl of heavy crude and 14.6 million bbl of light crude. [Ref. 68: p. 16] Senegal's proved natural gas reserves are considered sufficient to fuel the gas turbine electric power plant they now supply until 1995. [Ref. 69: p. 246]

C. TOGO-BENIN

1. General

Oil was discovered in Benin by the Union Oil Company of California in 1968. At that time, the find was considered unprofitable for development and the field reverted to the government of Benin. Ten years and several oil price increases later, the government finally found a firm willing to tackle the development of the field -- Saga Petroleum AS, of Norway. The field is being developed via a service contract for the government of Benin. Saga has no equity interest and is concerned only with the field's management. Benin borrowed the development capital, and Norway is guaranteeing 90 percent of the loan. [Ref. 70: p. 69]

2. Production and Exploration

Development of Seme field, which began 14 April 1980, is expected to cost $125 million. [Ref. 71: p. 70] The field is located 12.5 miles offshore and is scheduled to come on production in November 1982, with an output of between 5,000 and 15,000 b/d (see Fig. 18). [Ref. 33: p. 5345; 72: p. 2] The field has heavy 22.0 gravity crude and is still considered to be a marginal operation, but even with a production rate of only 5,000 b/d, it would provide enough to satisfy Benin's oil needs, with approximately 652,000 bbl a year left for export. [Ref. 9: p. 13; 20: p. 192]

While Benin is well on its way to becoming an oil exporter in 1982, its next door neighbor, Togo, has not been as lucky. The Togolese government has actively encouraged exploration and several companies have prospected some of its likely areas. In 1978, its entire offshore concession was awarded to Oceanic Resources of the U.S. [Ref. 33: p. 5345] In an earlier effort, Union Carbide Corporation drilled two offshore wells that had noncommercial shows (see Fig. 18). [Ref. 22: p. 49]

3. Reserves and Potential

The Dahomey and Niger Cone Basins, which cover the entire Togo-Benin offshore areas, were discussed earlier, as was the Volta Basin, which occupies a portion of Togo. [Ref. 22: pp. 14-16, 52-58] Although Benin's Seme field has crude oil reserves estimated at 20 to 22 million bbl, the likelihood

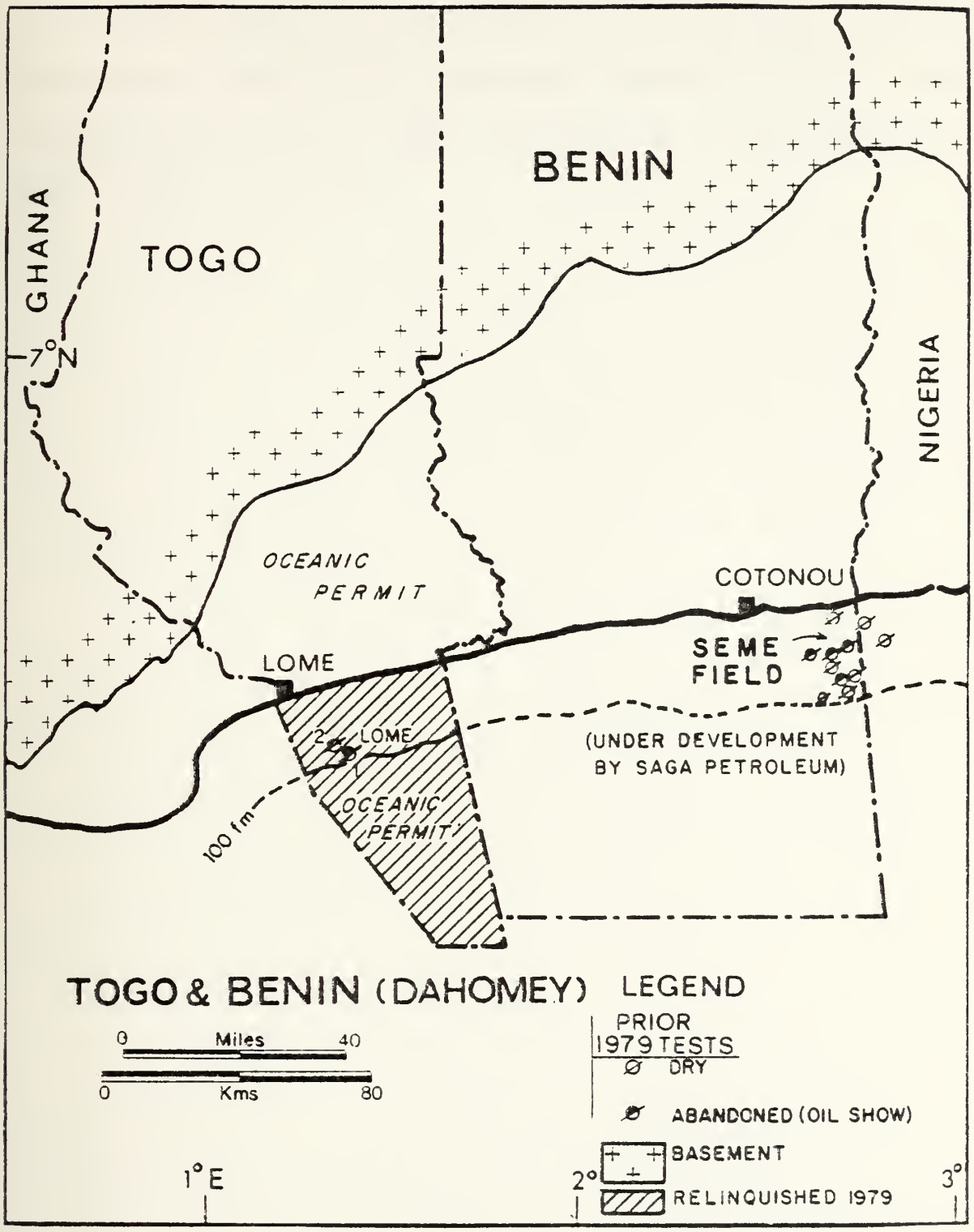

Figure 18. Togo and Benin: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 62: p. 1802]

of major discoveries by either country is diminished by the small basin area that is available to them. However, two of the basins have known hydrocarbon deposits, and the Togo-Benin offshore area has been classified as a high potential area. [Ref. 20: p. 192]

IV. POTENTIAL PETROLEUM PRODUCING COUNTRIES

A. CHAD

1. General

Drilling for oil in land-locked Chad began in December 1973, following three years of exploration by Conoco, partner in a group with Esso, Shell and Chevron. The group had two significant discoveries, one in the Kanem region north of Lake Chad, and another in the Salamat region in the Chari Basin (see Fig 19); but the country's civil war stalled both operations. [Ref. 26: p. 15; 9: p. 19]

The terms for Conoco's permits are for five years, with options for two five year renewals. The contract obligated the group to spend at least $5.67 million in the first five years, but over $18 million were spent the first four years. The government of Chad retains the ownership of all petroleum resources and companies who engage in exploration must state specifically in their contract the details of each proposed activity. [Ref. 26: p. 15]

2. Production and Exploration

After seven years of exploration, oil production began briefly at the Kanem field at a rate of 1,500 b/d, and Conoco had begun building a pipeline to transport the oil to the refinery at Ndjamena when the company shut down operations for security reasons in late 1979. Conoco has made a total

of five discoveries -- the finds in the Salamat region are considered worthy of exploitation. [Ref. 9: p. 19] Esso is also conducting exploration, and the results have made the company hopeful that commercial reserves will eventually be proven in Chad. [Ref. 73: p. 5] In January 1982 there was one active rig in Chad. [Ref. 13: p. 178]

3. Reserves and Potential

The Niger-Chad Basin, which extends from eastern Mali to the Central African Republic and covers a large portion of Chad, was believed to have very little oil and gas potential. However, limited wildcat successes have renewed geological interest in the basin, particularly in the Lake Chad and Salamat regions, where the Benue Trough from Nigeria intersects the Niger-Chad Basin. The relationship of the two discovery areas in Chad, and their overall relationship to the Benue Trough is poorly understood. It is believed, however, that the discoveries in the two exploration areas are significant, but they require further evaluation. [Ref. 22: pp. 16-28] Exxon's Vice President for Production stated that "...the potential petroleum plays [in Chad] are diverse and have a high risk of turning out dry -- but there is an outside chance of finding very large reserves." [Ref. 73: p. 5]

B. CENTRAL AFRICAN REPUBLIC (CAR)

Geologically, the Central African Republic is relatively devoid of sedimentary structures having hydrocarbon potential.

The only area thought to have possibilities is a narrow strip of land along the border with Chad, where the Niger-Chad Basin extends slightly into the country (see Fig. 19). [Ref. 22: pp. 20-22] Exploration for petroleum in the Republic has been limited to seismic and gravity surveys. The Conoco, Esso, Shell, Chevron group had seismic teams in the country in 1977 and 1979, and planned to resume its seismic work in 1981; Esso is currently conducting seismic exploration in the area. [Ref. 73: p. 5] Exploration activities in this border region are an extension of the play in Chad where oil and gas discoveries in 1979 indicate a definite possibility of future oil discoveries in the Central African Republic. [Ref. 22: p. 28]

C. NIGER

There has been considerable exploration interest in Niger since 1960, involving Conoco, Sunoil, Texaco, Esso, Shell, and Elf Aquitaine. Several exploratory wells have been drilled in the country, and at least one, a Texaco-Esso well drilled in the Tin Toumna region of the Sahara Desert north of Lake Chad, had hydrocarbon shows (see Fig. 20). [Ref. 26: p. 17] Niger is geographically similar to Chad, but the Niger-Chad Basin which covers most of the country is believed to have only a minor oil and gas potential in its deeper graben areas. [Ref. 22: pp. 16-22] The region with the greatest potential may be in the Lake Chad region. The

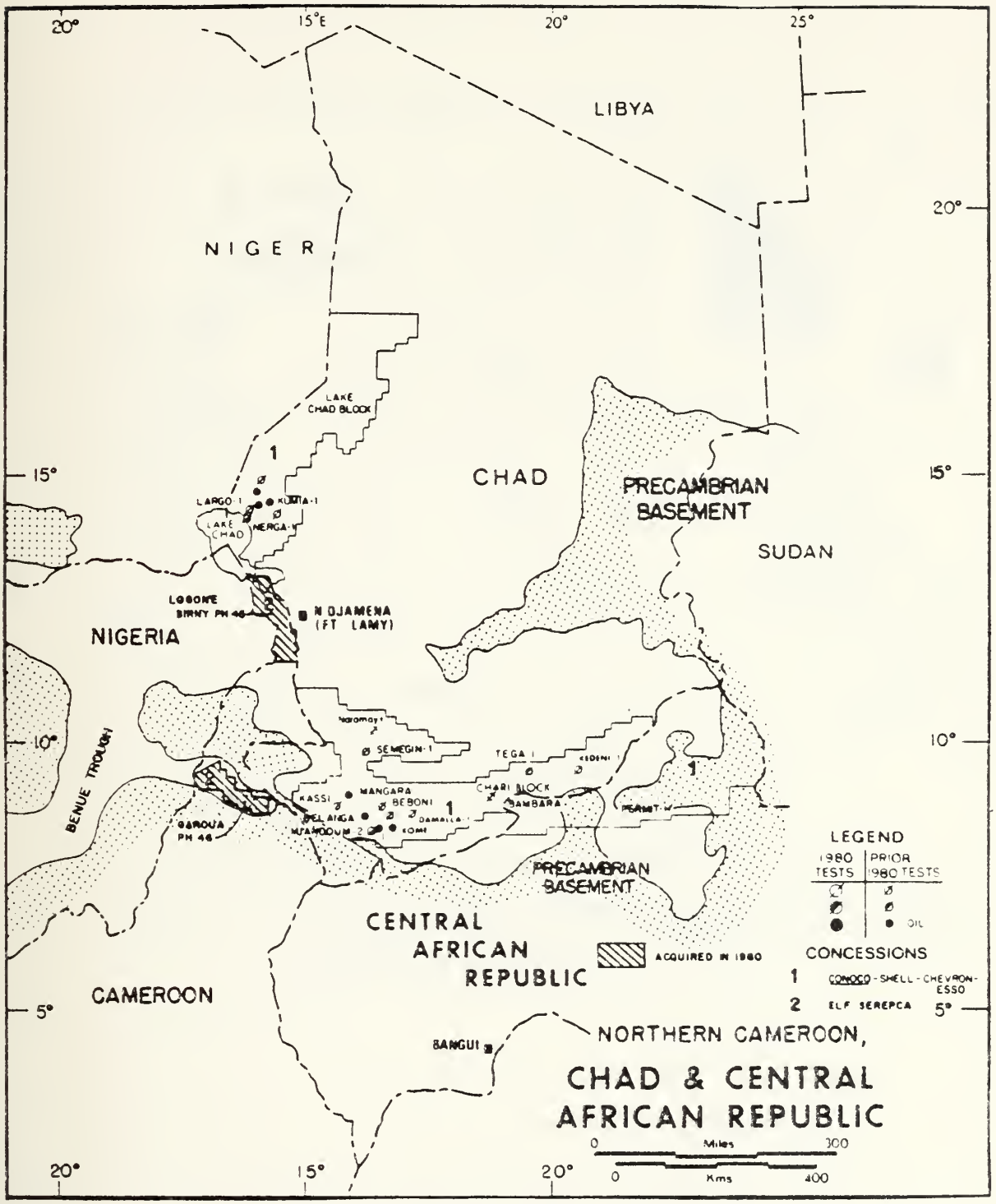

Figure 19. Northern Cameroon, Chad, and Central African Republic: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2096]

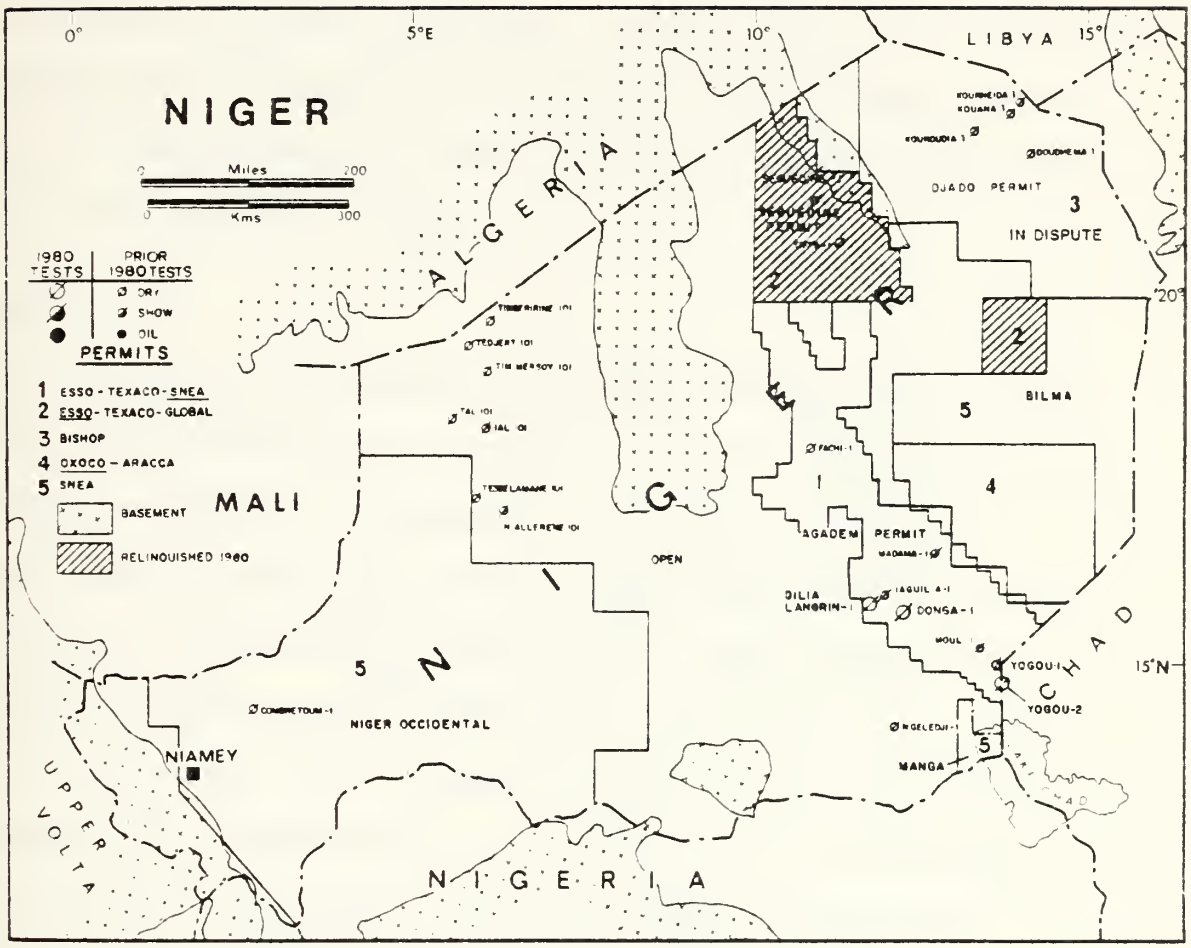

Figure 20. Niger: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2119]

Nigerian National Petroleum Corporation believes there are potentially large oil deposits in the lake area and has announced that it will drill three exploratory wells in the Nigerian portion of the lake basin. [Ref. 23: p. 18] Niger has offered new concessions to encourage exploration in the country, and as of January 1982 there were five drilling rigs active in the country. [Ref. 13: p. 178]

D. MALI

Exploration of the Taoudeni and Niger-Chad Basins in Mali probably was spurred by the large oil and gas discoveries in the related geological formations in Algeria. Currently, Elf Aquitaine is conducting seismic exploration in the northern portion of the Taoudeni Basin, while Esso is drilling a well in the southern part of the basin (see Fig. 21). [Ref. 74: p. 5; 73: p. 3] Both companies feel that the basin has the potential for commercial discoveries, and to encourage evaluation of the potential, the World Bank has extended a loan to Mali for petroleum exploration. [Ref. 23: p. 18] Although the Taoudeni Basin covers 500,000 square kilometers of Mali, the rock structures that produce oil and gas for Algeria aren't as thick as in Mali, and they may not have been adequately sealed throughout much of their hydrocarbon forming history. [Ref. 75: p. 2; 22: pp. 9-14] In addition to Mali's parsimonious geological endowments, the remoteness of the region would require a relatively large discovery in order for it to be commercially feasible for development.

Figure 21. Mali: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2117]

E. GUINEA - GUINEA-BISSAU

1. General

Onshore and near-shore petroleum exploration in Guinea and Guinea-Bissau during their late colonial period, by several multinational oil companies, failed to produce results for either country. The findings of an Esso campaign, off Guinea-Bissau from 1966 to 1974, were officially described as indefinite -- "...carried out in limited areas and at limited depths." [Ref. 76: p. 14] Later in Guinea, three offshore campaigns that covered 7695 square kilometers, from December 1973 through August 1980, produced equally "indefinite" results. [Ref. 77: p. 12] Renewed offshore activity by Senegal and the results of a Guinea-Bissau sponsored survey of offshore potential have interested both countries in offshore exploration again. However, their efforts to acquire "instant oil wealth" have precipitated a dispute over the ownership of the offshore areas thought to have some of the best exploration possibilities

Guinea-Bissau has established a state-owned corporation, PETROMINAS, to manage its petroleum interests, and has hired the New York-Lisbon based Atlantic Resources to organize the collection of geophysical data. [Ref. 76: p. 14] The data is to be used as the basis for international competition for drilling concessions by means of a "call for bids." [Ref. 78: p. 5] The exploration phase of this effort was financed by a $6.8 million credit from the World Bank. [Ref. 40: p. 21]

Guinea has also formed a state-owned company, SOGUIP, and hired the German firm, Geosurvey International, to survey its continental shelf and some of its onshore areas. [Ref. 77: p. 12; 26: p. 16]

2. Production and Exploration

The major thrust of Guinea-Bissau's recent exploration efforts has been on the continental shelf beyond contested areas (see Fig. 17). Under the direction of Atlantic Research, the British firm, DIGICON, began seismic work off Guinea-Bissau on 3 February 1981. [Ref. 79: p. 3] When the results of the DIGICON survey were released, 30 international oil companies expressed interest in obtaining concessions. [Ref. 80: p. 8] In December 1981, Guinea concluded an oil and gas exploration contract with an Australian group, Bright Oil. The contract, with both on and offshore rights, commits the group to spend $15 million per year for three years and to begin drilling in 1983. [Ref. 81: p. 3303]

3. Reserves and Potential

Guinea Bissau has access to only one sedimentary basin capable of producing petroleum, the Senegal Basin, which is generally believed to lack the physical properties necessary to generate large quantities of hydrocarbons. This conclusion is based on the relatively intense exploration that the region has received and the fact that geologically it has been a "cold" basin. [Ref. 22: pp. 35-36] However, a recent study by the Belgian Engineer, George Brognon, who discovered large

reservoirs of oil in Angola, differs with this opinion. Mr. Brognon's study concluded that, in addition to the known deposit at Dome Flor, the more distant offshore areas along the outer reaches of Guinea and Guinea-Bissau's contintental shelf have a high probability of producing commercial reserves. [Ref. 78: p. 5]

F. LIBERIA - SIERRA LEONE

1. General

For the first time in several years oil exploration activity is beginning again in both Sierra Leone and Liberia. Sierra Leone, whose oil imports consume almost all of the country's foreign exchange earnings, reported in May 1981 that oil had been found in the Turner's Peninsula area but no figures were released. [Ref. 9: p. 66] Oil exploration in Liberia had been limited to four offshore wells drilled before 1973 by three U.S. companies. Although hydrocarbon deposits were found in the wells, the exploration effort was abandoned. [Ref. 82: p. 118]

Liberia's Bureau of Hydrocarbons has been given the responsibility for managing the country's petroleum development interests. Liberia has also hired J.C. Ferrand and Associates of Houston to compile a geological and geophysical study of Liberia's potential oil and gas bearing regions. Interested oil companies must purchase the study at a cost of $350,000 before submitting exploration proposals to the government. Contracts will be awarded under Liberia's revised Petroleum

Act which stipulates a production sharing agreement providing for accelerated recovery of oil company expenditures, followed by an escalation of the government's share based on increases in the pretax rate of return. [Ref. 83: p. 70] Sierra Leone's Parlimentary Exploration, Mining, and Processing of Mineral Oil Agreement requires oil companies to pay a cash bonus of 20 Lebnes per retained square mile of land with exploitable discoveries. The companies must also pay a cash bonus of $500,000 when production for any 30-day period reaches 75,000 b/d, $2 million for 200,000 b/d, and $3 million for 300,000 b/d. [Ref. 84: p. 2]

2. Production and Exploration

In Sierra Leone, Mobil is acting as the operator on several offshore concessions held by the Arracca Group of Oxoco, Sundance, and Mobil (see Fig. 22). [Ref. 85: p. 296] A wildcat drilled by Mobil off Turner's point in June 1981 produced oil and gas shows, and Mobil called its geophysical exploration ship, the T.W. Nelson, to the site to survey a more detailed grid location of likely oil structures for the final positioning of drilling rigs. [Ref. 85: p. 296; 86: p. 1] Mobil plans to resume test drilling in April 1982 and if commercial deposits are found, production could begin in 1985. Sierra Leone has also granted a concession to two U.S. oil companies for onshore exploration. [Ref. 87: p. 56]

Liberia has granted a 1.2 million acre onshore concession to Katana Resources of Canada. The grant includes rights to

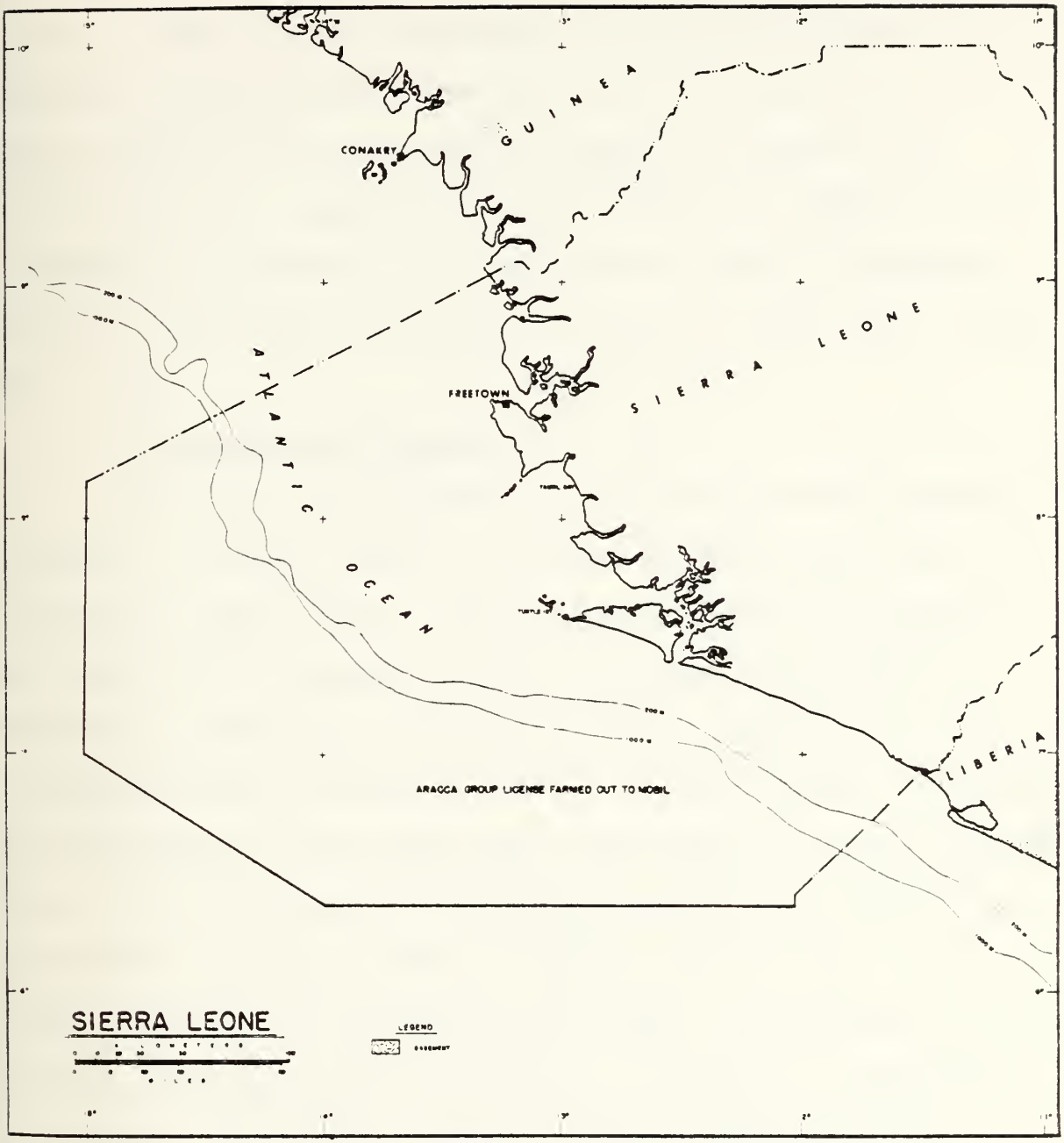

Figure 22: Sierra Leone: Aracca-Mobil concession. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2125]

the Roberts and Bassa sub-basins. [Ref. 88: p. 12] Katana's geologists are mainly interested in the Roberts Basin in the Monrovia area, where a geochemical survey has indicated the presence of hydrocarbons (see Fig. 23). The first of two Katana wildcats was scheduled to begin on 14 March 1982. [Ref. 83: p. 70] Approximately two dozen oil companies have expressed an interest in concessions to Liberia's offshore regions, which were to be opened for bid in June 1982. [Ref. 82: p. 118]

3. Reserves and Potential

The only large sedimentary regions with hydrocarbon potential in Sierra Leone or Liberia are the coastal and continental shelf areas. Until recently, the oil industry had shown little interest in the area because of the thin sedimentary sections, and because seismic surveys had indicated a possible lack of reservoir rocks. A much thicker sedimentary section underlies the lower slope and rise of the continental shelf, and there may be structural similarities with similar regions off the Ivory Coast. [Ref. 22: pp. 37-42] In a recent interview, a Mobil official rated Sierra Leone's oil and gas potential as fair to good. In Liberia, preliminary geological evaluations by Katana's geologists indicate a potential for hydrocarbon entrapments that they believe are very similar to those off the Ivory Coast. [Ref. 88: p. 12]

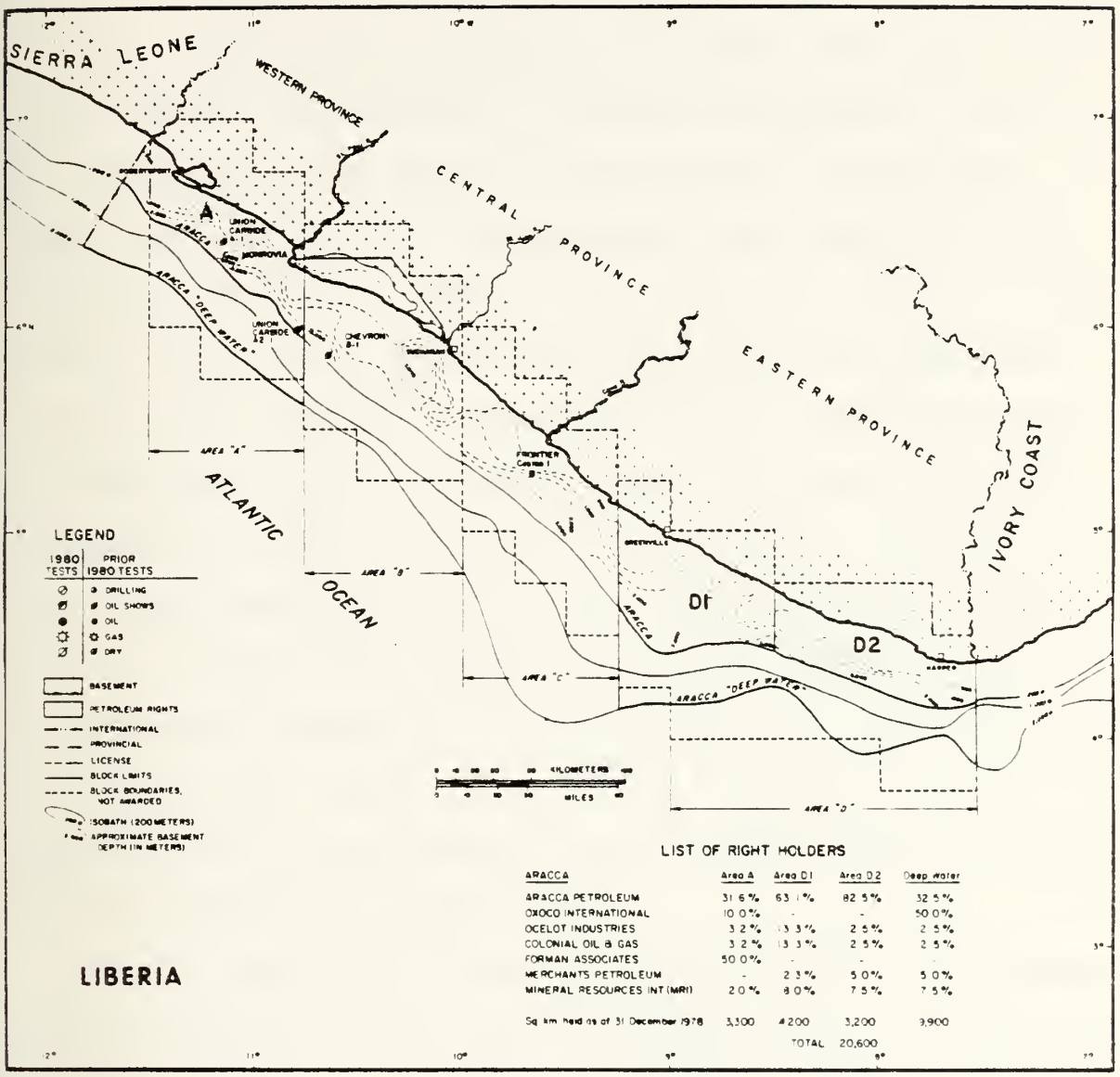

Figure 23: Liberia: concessions and key wells. Reprinted by permission of the American Association of Petroleum Geologists. [Ref. 2: p. 2115]

V. CONSTRAINTS ON THE DEVELOPMENT OF PETROLEUM RESOURCES

West African oil has several advantages over oil from other regions, particularly for Western consumers. First, oil produced in West Africa is conveniently located near Western markets and has transportation advantages over oil from the Middle East. Much of West Africa's crude oil is high quality light crude, which has a high gasoline content and satisfies the technical requirements of many Western refineries. The petroleum tax laws of West African producing countries are generally less developed than the systems in force both in the OPEC countries and the North Sea; taxes on petroleum profits in West Africa average less than 50 percent, compared to more than 80 percent in the North Sea, and even higher in the Middle East. [Ref. 18: p. 44-45] Finally, the West African region is considered to be politically more stable than its Middle East counterpart.

Despite the many advantages that West African oil supplies have for Western Markets, the development of oil in this region is dependent upon several critical factors. One of the most important variables affecting the development of West African oil reserves is the international economics of supply and demand for petroleum products. Most deposits of oil and gas in West Africa are commercially marginal propositions. It was the higher oil prices after 1973 that provided the

incentive to intensify the search for new oil deposits and to increase output from existing fields in the region. However, because oil and gas from other sources, such as the Persian Gulf is significantly less expensive to produce, the development of West African petroleum resources depends upon international demand levels and price structures that will induce oil companies to continue to make the necessary investments.

One indicator that can be used to judge a region's economic potential as a petroleum producer is its level of drilling activity. It has been estimated that the ratio of oil wells drilled in the United States, when compared to the number of wells drilled in developing countries is 140-to-1. Until recently, West Africa's drilling activity was even lower; but in 1982, approximately 2,000 oil and gas wells will be drilled off the coast, which is almost twice as many as in 1981. [Ref. 21: p. 86] Regardless of the economics of supply and demand, it is apparent that leaders of the "have-not" nations are going to keep pressing for the development of their domestic oil supplies. Nonetheless, there are physical and political constraints at work which can blunt the ambitions of national leaders and dampen the enthusiasm of private investors, even in oil regions that are potentially lucrative.

One of the major constraints that oil producers in West Africa must contend with is the physical nature of the region itself. West Africa is known in the trade as a "harsh

environment" for oil production -- it is not an easy area in which to operate. For instance, many of Nigeria's most productive oil fields are located in the muck of the Niger Delta swamp; onshore exploration in Zaire must contend with dense tropical jungles; and many countries like land-locked Chad, Mali, and Niger have almost no infrastructure for access, transportation, or processing of their potential petroleum reserves. Even West Africa's geology contributes to the region's difficult operating conditions. Typically, West Africa's oil bearing structures tend to trap hydrocarbons in many small, shallow pockets, rather than in large reservoirs as in Mexico or Saudi Arabia. This not only makes the deposits more difficult to locate, it also requires many small wells, which are more expensive than a few large wells. Moreover, the deposits tend to be widely dispersed; many occur in deep water, over irregular seabeds; or they have extremely high pressures and heat -- all of which require the latest and most expensive technology, and add years to development lead times. [Ref. 89: p. 275]

For reasons of cost and technology, West Africa's most readily accessible prospective areas were explored first, and as a result, exploration has progressively moved into even harsher environments -- the deeper offshore and more remote continental interior -- where time to position and drill a well takes much longer and the cost is much higher. For example, onshore wells in mature producing areas, such as the

U.S., could be drilled in 1979 for up to $100,000; similar wells in the interior of Africa were costing $3 to $5 million, and deepwater offshore wells, $20 million or more. [Ref. 89: p. 265]

It should be emphasized that the prospect of small discoveries is not a factor which inhibits the exploration of new areas. Improvements in exploration technology have enhanced the oil industry's ability to find smaller fields, consequently, the number of discoveries and volume of reserves found in smaller fields have been steadily increasing. Despite their economic drawbacks, small fields can be important to a developing country, and cumulatively to the diversity and total size of an oil company's reserves. [Ref. 89: pp. 275-279]

The other potential constraint to the development of West African oil is political. Once a region is perceived to have geological potential for hydrocarbons, two conditions must be fulfilled before exploration can occur: there must be access to the acreage and the terms of exploration must be acceptable to all parties involved. [Ref. 89: p. 262] Both of these conditions are determined by government policies which are not always consistent with oil companies' views of their own economic needs. Even when satisfactory conditions are established at the outset, arbitrary changes to the rules can be introduced by a government, increasing the explorer's risk substantially.

Citing the Nigeria case, a senior Mobil executive made the point that "since it entered Nigeria to explore for oil in 1955, Mobil's business has been affected more by government policy than anything else except for our own success in establishing commercial production." [Ref. 90: p. 3] Nigeria has a long history of changing the rules of the game, for both political and economic reasons: in April 1971, Elf-Aquitaine was forced to sell 35 percent of its Nigerian operations to Nigeria; in July 1971, Nigeria joined OPEC and adopted OPEC guidelines in its dealings with foreign oil companies; in 1977, Nigeria formed the Nigerian National Petroleum Company (NNPC) and nationalized Esso's local marketing subsidiary; in 1979, Nigeria introduced "service only" contracts which deny new foreign operators equity shares in production; in August 1979, Nigeria nationalized all of British Petroleum's Nigerian operations; and in 1980, the "Oilgate" scandal paralyzed the NNPC and all of its long term hydrocarbon development projects with foreign oil companies. [Ref. 9: pp. 57-58]

Nigeria is not by any means the only troublesome oil producing nation in West Africa. Almost every oil producing nation is currently angling to get a larger share of the petroleum profits, while the foreign oil companies are working to achieve the opposite ends. Angola and Nigeria are two examples of countries who have established production celings or allowables to stretch out the depletion of their reserves, which also stretches out the time it takes for oil companies

to recover their expenses. Local bureaucracies up and down the West African coast make conducting day-to-day business a lengthy and frustrating process that is exacerbated by institutionalized corruption. [Ref. 15: p. 48] Finally, there are countries like Angola with endemic political instability, where Gulf Oil Corporation has withstood two decades of revolution, and where potentially productive regions like the Estosha Basin cannot be explored until hostilities are arrested. However, the industry's widespread drilling history suggests that most political constraints, short of open hostility, can be overcome if geologic prospects are good. [Ref. 89: p. 279]

The overriding consideration governing oil company investment in West Africa has been their estimates of international demand for petroleum products, and with few exceptions, political constraints have not significantly dampened their activities or interests in the development of West Africa's reserves. It is true that political factors halted the operations of Conoco in Chad in 1979, Gulf in Angola in 1975, deterred development investment in Ghana following the Rawlings' coup, and contributed to Nigeria's inability to interest oil companies in offers to expand their exploration into new regions in 1979; but on the whole, the politics of West Africa have been more of a frustration than a constraint on the operations of oil companies; however, if foreign oil company executives perceive a long-term decline developing in

the international demand for crude oil, West African politics could become a decisive factor in the future investment calculus of the foreign oil companies.

VI. REGIONAL CAPABILITY AND POTENTIAL

The petroleum industry in West Africa began late and developed slowly; production first began in 1956 in Angola, followed by Gabon in 1957, Nigeria in 1958, and the Congo in 1960. After that, there was a 15 year lull in activity, until a flurry of new discoveries introduced five more West African oil producers. First, it was Zaire in 1975, then Cameroon in 1977, Ghana in 1978, Chad flickered briefly in 1979, and the Ivory Coast came on stream in 1980. Today, almost every West African country from the Ivory Coast to Angola has an oil discovery that is in commercial production, and by 1986, Benin, Senegal, and Equatorial Guinea could join the list.

With 2,191 wells on production, output from the West African region was slightly over 2.7 million b/d in 1979 -- the bulk of it, 2.3 million b/d coming from Nigeria. [Ref. 44: pp. 40-42] In January 1982, there were 79 active drilling rigs in West Africa, which was a 58 percent increase over the previous year, and the region's 100 percent rig utilization rate in 1980-81 was the world's highest. [Ref. 13: p. 178; 91: p. 125] Despite vastly improved production capacities by most West African countries, and a very high level of exploration and development activity, the 1980-81 slack in world demand for crude oil caused a decline of 27 percent in West Africa's 1981 output. Nigeria suffered the brunt of the

cut-back with a 33.2 percent production slump. Table 8 depicts the trends in West African crude oil production from 1976 to 1981.

Table 8

WEST AFRICA: CRUDE OIL PRODUCTION TRENDS ('000 b/d)

	1976	1977	1978	1979	1980	1981
Angola	151.9	141.8	136.3	145.2	148.6	140.0
Cameroon	. . .	.8	12.5	35.1	79.3	87.0
Congo	35.7	32.9	49.2	55.2	65.9	79.0
Gabon	227.5	226.3	212.9	196.8	178.6	147.0
Ghana	. . .	. . .	5.0	5.0	2.1	2.1
Ivory Coast	. . .	. . .	. . .	. . .	7.0	7.0
Nigeria	2,078.1	2,067.8	1,902.9	2,299.4	2,038.8	1,369.0
Zaire	25.1	22.6	22.9	20.7	17.7	20.0
Total	2,518.3	2,492.2	2,341.7	2,757.4	2,538.0	1,851.1

[Ref. 9: pp. 12-83; 12: p. 87]

Estimates of a region's potential or capability to produce petroleum are based on the conventions of probability, which at best are subject to errors in expert judgement, and at worst, to the tendency of the "official mind" to assume implicitly that supply is somehow unresponsive to price changes For example, in the 1880's, the U.S. Geological Survey solemnly reported that little if any oil of commercial value would be found in Texas or California. [Ref. 92: p. 5] Equally gloomy reports can be found about the west coast of Africa; among them, as recently as 1980, the Ivory Coast was believed to possess only a modest potential, and Equatorial Guinea was not even recognized as a potential player. Yet today, West

Africa has 35 percent of Africa's proved oil reserves and 21 percent of the continent's proved natural gas reserves. [Ref. 16: p. 52]

On 1 January 1982, West Africa's estimated proved crude oil reserves stood at 20.7 billion bbl and natural gas reserves were 49.2 trillion cu. ft. The estimated proved reserves of each country are shown in Table 9.

Table 9

WEST AFRICA: ESTIMATED PROVED RESERVES, 1 JANUARY 1982

	OIL*	GAS**
Angola	1,450,000	1,030
Cameroon	480,000	4,600
Congo	1,300,000	2,500
Gabon	480,000	490
Ghana	2,310	. . .
Ivory Coast	314,000	37
Nigeria	16,500,000	40,500
Zaire	145,000	50
Total	20,671,310	49,207

*(1,000 bbl)
**(billion cu. ft.)

[Ref. 12: p. 87]

The first law of petroleum economics says that discoveries are directly proportional to investment made in exploration; and recent discoveries, such as the Phillips Espoir find, have apparently motivated the multinational oil companies to redouble their commitment in West Africa. In 1980, spending by U.S. oil companies in West Africa was estimated to be only $942 million; but in 1981, spending jumped to $1.565 billion,

and current plans call for outlays of $1,755 billion in 1982 and $5.399 billion in 1983 -- an increase of 350 percent over the 1981 level. [Ref. 93: p. 5]

While most of West Africa's oil discoveries have been in the small category commercially, there have been some important surprises; and current reserves and production figures are likely to rise as more recently discovered fields are defined and put into production in the near future. Exploration efforts underway in the region, could, by 1985, yield an additional oil flow of at least 1.0 million b/d, and output could go even higher if politically imposed production allowables are relaxed. According to Petroconsultants of Houston, by 1990 Benin, Cameroon, Equatorial Guinea, Ghana, and the Ivory Coast could be producing at rates of from 15,000 b/d for Equatorial Guinea to 360,000 b/d for the Ivory Coast. [Ref. 94: p. 58] An indication of the region's petroleum export potential can be seen in Table 10 which contains the estimated ultimate production capacities and the 1979 domestic oil consumption rates for the countries listed.

Substantial increases in West African natural gas production are also anticipated in the next decade. A recent study identified 16 countries in Sub-Saharan Africa with some potential for natural gas production; twelve of the countries were in West Africa and eight already have proved gas reserves. [Ref. 95: p. 100] However, natural gas production has several inherent problems, not encountered with crude oil, that must

Table 10

WEST AFRICA: CRUDE OIL EXPORT POTENTIAL (b/d)

	Ultimate Production Capacity*	Domestic Consumption (1979)
Angola	300,000	12,300
Benin	15,000	2,840
Cameroon	200,000	10,000
Congo	200,000	4,000
Equatorial Guinea	15,000	500
Gabon	180,000	11,200
Ghana	50,000	17,640
Ivory Coast	200,000	26,520
Nigeria	2,300,000	62,000**
Senegal	160,000	20,000
Zaire	30,000	16,000
West Africa Total	3,650,000 b/d	183,000 b/d

*These are estimates of West Africa's physical capability to produce oil and are based on the assumption that the necessary political and economic conditions will exist to permit full development of the region's petroleum reserves.

**Nigeria's domestic oil consumption increased to an average of 165,800 b/d in 1980. Domestic oil consumption for the countries listed is estimated to be approximately 500,000 b/d in the year 2000.

[Source: compilation of previously cited references]

be overcome before any potential can be realized. The largest and perhaps overwhelming disadvantage is the tremendous amount of capital required for gas collection systems, liquefaction/regasification facilities, LNG tankers, terminals for the tankers, and LNG storage facilities. Assuming these requirements are satisfied, Africa could be producing over 25 percent of the world's supply of natural gas by 1990, and if the economic incentive increases to prove up new gas reserves,

up to half of Africa's gas production could come from West African reserves.* [Ref. 96: p. 35]

In effect there has been an "oil rush" on West Africa, but considering lead times on the order of six to twelve years from initial discovery to development of commercial production, much remains to be done. It has been estimated that as much as 80 percent of Africa's petroleum reserves remain to be discovered, and that discoverable reserves on the continent and offshore, over the next 20 years, could reach 51.3 billion bbl, or 14 percent of worldwide discoveries in the same period. [Ref. 26: p. 3; 44: pp. 40-42] Appreciable amounts of this oil will undoubtedly come from countries in West Africa--yet, many of those countries have not been drilled with sufficient intensity to evaluate their petroleum potential. [Ref. 95: p. 104] For instance, Elf Aquitaine's geologists say that, except for a few areas, large portions of the offshore from the southern border of Gabon to Namibia remain relatively untouched and many years of potentially productive drilling lie ahead for the countries there. [Ref. 23: p. 18] Table 11 shows the potential for future discoveries of commercial value in the West African countries.

Obviously West Africa has not been thoroughly explored and more petroleum remains to be discovered there. But the

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*Obviously, such predictions are problematical since they assume no changes in gas production elsewhere in the world.

Table 11

POTENTIAL FOR NEW COMMERCIAL DISCOVERIES IN WEST AFRICA

	EXCELLENT	GOOD	FAIR	MARGINAL
Angola	X			
Benin			X	
Cameroon	X			
Central African Rep.			X	
Chad		X		
Congo	X			
Equatorial Guinea		X		
Gabon		X		
Ghana			X	
Guinea			X	
Guinea-Bissau			X	
Ivory Coast	X			
Liberia			X	
Mali				X
Niger				X
Nigeria	X			
Senegal			X	
Sierra Leone			X	
Togo			X	
Zaire		X		

[Source: Compilation of previously cited references and author's conclusions]

key question is, how much will be found -- will discoveries in West Africa be large enough to alter the free world's dependence on oil from the Persian Gulf? On a global scale, half of the world's known oil reserves are in 28 super-giant fields, with more than five billion bbl each; twenty-four of these are in the Middle East and there is one each in Venezuela, Mexico, Texas, and the North Slope. [Ref. 89: p. 258] Few of the basins which have been explored in recent years have contained structures where super-giant fields might be found, and none of the unexplored basins appear to have the geologic

characteristics required for a series of super-giants. Thus, the prospects of finding another Middle East would appear to be nil. To the contrary, the number of discoveries and volume of reserves found in smaller fields (fewer than 50 million bbl) has been steadily increasing, and the smaller fields are tending to become the prime exploration targets. [Ref. 89: p. 258]

From 1950 to 1975, 800 exploratory wells were drilled in the Persian Gulf region, finding more than 200 billion bbl of crude oil, while West Africa, with over 2100 wells, has produced reserves of slightly over 20 billion bbl. [Ref. 1: p. 205] At their peak production level in 1979, the Persian Gulf countries were producing 21.1 million b/d; in March 1982, their output had fallen to 12.15 million b/d, giving them an excess production capacity of 8.85 million b/d. [Ref. 97: p. 9] 1979 was also West Africa's peak production year, with 2.75 million b/d; however, current excess production capacity is less than one million b/d. If there was a maximum effort by all parties in West Africa, the region's production capacity might eventually reach 5.0 million b/d.

Considering that it took the West Africans almost three times as many wells, spread over a much larger area, to produce one-tenth the reserves and output of the Persian Gulf, it does not seem plausible to assume that West African petroleum will likely diminish the importance of the Persian Gulf, especially since a small but increasing percentage of

West African production will probably be required for domestic consumption. Barring very large discoveries, the combined output from new and future West African producers is unlikely to challenge Nigeria as the region's preeminent oil producer. Still the opportunity posed by West Africa remains great. Large gaps exist in our knowledge of West Africa's petroleum potential, and even if the probability of discovering giant or supergiant oil fields is very low, there is a high probability that many profitable fields are still to be found.

VII. ECONOMIC IMPLICATIONS OF OIL: THE OIL SYNDROME

The recent oil boom in West Africa has predictably generated increasingly optimistic hopes regarding the region's growth potential. Many African leaders view oil as a "mystical elixer" that can fuel their countries' long-awaited economic takeoffs and lead to more social cohesion, greater political stability, meaningful industrialization, and an eventual advanced-country status. [Ref. 98: p. 814] However, justifications for these expectations are both over-stated and difficult to document. In fact, the record is rather clear that the discovery of oil in most developing countries has been, at best, a mixed blessing. [Ref. 98: p. 815]

While the beneficial aspects of oil income, such as more favorable balance of payments, higher economic growth rates, increased stability for economic planning, and in some cases, higher standards of living, are undeniable, political and economic forces at work in Sub-Saharan Africa can make it difficult to translate these benefits into lasting economic development. The introduction of oil revenues can actually serve to exacerbate rather than alleviate development problems. [Ref. 58: p. 2] Moreover, few oil-exporting countries have found a strategy that can solve the distributional problems created by a sudden influx of petroleum revenues. These problems include: 1) transforming their oil revenues into

long-term economic infrastructure with a capacity for self-sustained growth through a balanced economy; and 2) equitably distributing the energy resources and the revenues derived from them along regional, sectoral, and social lines. [Ref. 99: p. 4] These problems have recurred so frequently in so many different countries with dissimilar economies that analysts have begun to view them as part of an overall socio-economic dysfunction called the "oil syndrome". [Ref. 98: p. 815] Four elements of this syndrome are particularly relevant to the West Africa case.

First, petroleum extraction is almost always an enclave sector. Because of the skills and capital required, the petroleum industry in third world countries is inherently more externally oriented than agriculture or manufacturing industries. Backward and forward linkages with other sectors of the economy in the form of demand for goods and services are minimal. [Ref. 100: p. 1; 101: p. 1; 99: p. 3] In addition, the capital intensive nature of the oil industry means that large investments create few jobs for domestic labor. For example, oil provides over 90 percent of Nigeria's foreign earnings, but only absorbs one to two percent of its labor force; and in Gabon, oil employs only approximately 1,000 Gabonese. [Ref. 99: p. 3; 102: p. 3] Thus, the development of an oil industry is in itself not sufficient to provide the stimulus for sustained, balanced national economic development.

Second, the fact that petroleum is an exhaustible resource raises unique technical and politico-economic issues. First, there is the need to establish an optimal technical rate of extraction. [Ref. 99: p. 3] This rate varies from well to well and plays a significant role in determining the amount of oil that can ultimately be recovered over the life of a well. Second, the government must determine the optimal social rate of extraction -- i.e., the rate which will provide the best mix of short and long term returns to the economy and society as a whole. If the rate is too rapid, it may generate more revenue than the national economy is capable of absorbing productively, creating an inflationary situation. Rather than lose the nation's earnings through inflation, it may be more rational to leave the oil in the ground where it can appreciate and stretch the nation's income over more years. [Ref. 99: p. 4]

Third, increasing oil exports can indirectly undermine other sectors of the economy. As oil exports increase, the sudden influx of foreign exchange causes the domestic currency to appreciate relative to other currencies. This simultaneously reduces the international competitiveness of other domestic export sectors by increasing the price of their goods on foreign markets and the internal competitiveness of domestic producers by decreasing the relative prices of imported food and manufactured goods. Only non-traded goods and services such as construction are not adversely affected by the

increasing exchange rate differential. [Ref. 98: pp. 816, 822; 101: p. 1]

Fourth, the sudden sense of unlimited wealth that accompanies rising oil exports often leads to massive public spending that is not only wasteful, but harmful, both socially and economically. In most oil producing countries oil revenues go directly to the government. A predictable result has been an expansion of government payrolls, a boom in government funded construction, and more generally increased spending on prestige projects of dubious merit. Less insidiously, large injections of capital into the public sector can overload a country's physical and managerial infrastructure, leading to ill-conceived and inefficiently managed projects. [Ref. 98: pp. 822-826; 101: p. 1]

The real problem is not government spending *per se*; rather it is the timing of the spending that is critical. All oil exporting countries share the same three goals: to raise the living standards of the present generation, to follow a development strategy which can ensure the welfare of future generations, and to reduce dependence on oil through domestic economic diversification; and most of these countries have formulated development plans with targets to guide them toward these goals. The problem is that, once the goals have been agreed upon and targets set, there is a tendency to ignore the necessity of timing their investments in the proper sectors to optimize growth along a critical path. By allowing

investment to proceed either too rapidly or too slowly, distortion and inefficiency are injected into the development process. [Ref. 100]

By almost any measure, the classic example of the oil syndrome and its consequences can be found in present-day Nigeria. Arising in the mid-1970's, the oil syndrome affliction is a relatively recent phenomenon. The only nations in West Africa who were established as major oil exporters early enough to develop most of the symptoms are Nigeria and Gabon. Nigeria's pre-oil economy was one of Africa's most robust, with real GDP growing at an annual rate of 4.5 percent. Agriculture was the leading economic sector, as Nigeria was one of the world's largest exporters of peanuts, palm oil, and cocoa. Nigeria's manufacturing sector had grown from one percent of GDP in 1950, to five percent in 1964. Over the same period, expansion of the money supply averaged about four percent and the rate of inflation about one percent. In short, Nigeria's economic prospects, at the time looked bright, especially when compared to other black African nations. [Ref. 101: p. 1]

Following the 1967-1969 civil war, which decimated Nigeria's manufacturing and agriculture sectors, oil income shot up dramatically, from $189 million in 1964 to almost $24 billion in 1981. [Ref. 98: p. 817; 101: p. 1] The rapid influx of foreign exchange had immediate and disastrous effects on the Nigerian economy. First, in order to spread

more of the new wealth to urban workers, Nigeria's central bank kept the exchange rate of the domestic currency (naira) unrealistically high; and the policy of massive public spending, tempered only by the government's physical ability to organize the handing out of contracts, unleashed a self-perpetuating cycle of hyper-inflation. Consequently, foreign goods became steadily less expensive in naira (N) terms compared to domestic goods, spoiling the markets for domestic producers, driving savings out of the country, and increasing the incentive for smuggling. [Ref. 103: p. 5; 104: pp. 35-39] In this respect, oil allowed Nigeria to multiply its exports in dollar terms by ten times in ten years, and its imports by eleven times. [Ref. 105: p. 3]

While oil earnings were rising to claim over 90 percent of Nigeria's total foreign exchange, agriculture and manufacturing shrank from 58 percent of total GDP in 1964 to 20 percent in 1980. [Ref. 21: p. 85] Nigeria, which was once the region's largest food exporter, now has one of the most staggering food production problems in West Africa. Following the sharp increase in government spending in the early 1970s, thousands abandoned farming for higher paying jobs in the cities, and Nigeria plunged from food self-sufficiency to a nation dependent upon over $2.2 billion in annual imports of rice, frozen chickens, and other foods. [Ref. 106: p. 7; 107: p. 8] In the same vein, the migration of rural workers to urban centers in Gabon has reached such proportions that the

country now imports bananas from its neighbors, even though bananas grow abundantly in the wild. [Ref. 21: p. 85] All of the programs initiated by the Nigerian government to stimulate agriculture have failed because the prices offered to Nigerian farmers have been significantly less than it cost them to produce their crops and less than they could make by working in town. Consequently, the range of products which Nigeria can sell abroad has been narrowed to one: oil.

Instead of greater economic independence, built on a bonanza of petroleum receipts, President Shagari faces the dilema that Nigeria is less self-reliant today than when it became independent 22 years ago. [Ref. 108: p. 1] By publicly placing so much emphasis on its oil wealth and by seeking to use that wealth to satisfy the rising level of demands emanating from their country's deeply divided regional and ethnic groups, the actions of Nigeria's political leaders have exacerbated the problems associated with the oil syndrome. So far Nigeria has avoided the final step of that syndrome. Unlike Mexico, Nigeria has not yet begun to mortgage its future by using its oil reserves as collateral for large-scale international borrowing to finance growing government expenditures. However, future Nigerian leaders may find this a difficult trap to avoid as societal demands continue to escalate.

One oil producing West African country which apparently has recognized this problem is Cameroon. Using Nigeria and

Gabon as negative models, the Cameroonian government has decreed that a minimum of publicity shall be given to its oil industry. When there is an oil discovery, that is all the government announces; nothing is said about the size, type, or location of the strike. In addition, a large portion of Cameroon's oil earnings are held in overseas government bank accounts to avoid overheating the economy. The objective of this approach is to prevent an exodus of farm workers from the agricultural sectors and to keep a truly diversified economy. [Ref. 15: p. 54]

It would be an illusion to maintain that Cameroon doesn't have some major economic problems, but relative to most other oil exporters, so far its development scheme is attaining desired results. Cameroon's economy has been growing at a real rate of 6 percent, its currency reserves rose from $52 million in 1978 to $194 million in 1980, the budget increased by 26 percent in 1981, and 1980 was the first time that cocoa and coffee each earned less individually than did crude oil exports. [Ref. 19: p. 26; 109: p. 8] Cameroon's policies have kept the migration of workers to urban areas to a relative minimum, and by keeping market incentives high for its farmers, Cameroon has maintained its status as a food exporter.

Besides Cameroon, the Ivory Coast, the Congo, and possibly Gabon, have a chance to succeed in spite of their oil wealth. Presently Cameroon and the Ivory Coast have the

most mature outlook toward the windfall of oil revenues, nonetheless, the leaders of both countries will be severely tested to funnel their oil revenues into productive investments, and to avoid the temptations of political expediency. In the world history of petroleum development, only America has avoided the pitfalls of the oil syndrome. [Ref. 107: p. 4]

VII. POLITICAL IMPLICATIONS OF OIL

While development is undoubtedly the preeminent concern of the West African oil exporting countries, it is not the only worry of the African people; they are also concerned about threats to their security due to internal instability and external adventurism -- and oil based economic development has not necessarily led to either domestic or regional political stability. Very few West African states have been free of threats; for some there have been continued internal or border struggles for decades. The various sources of such instability are as old as the African people themselves, often having roots in long-standing ethnic rivalries or in border disputes arising from unclear and arbitrary colonial agreements that failed to recognize traditional tribal or familial land rights -- all have been exacerbated by the discovery of oil. Only Zaire, Ghana, and the Ivory Coast, among current West African oil producers, have not experienced oil induced political instability or interstate conflict.

A. DOMESTIC

The discovery of oil accompanied by large influxes of foreign exchange, even if properly managed, can produce economic shocks of a magnitude capable of distorting both a country's economy and its social fabric. The first symptom of approaching danger that politicians must address is a

sudden rise in expectations and a desire by the poor for the "good life" now. Failure to satisfy these expectations and to devise a politically acceptable method for distributing the wealth can unleash a host of destabalizing evils, including general domestic unrest, resurgence of ethnic rivalries and sectoral feuds, increased graft, corruption and crime, and possibly overthrow of the government.

This list is by no means exhaustive, but each example cited can claim a current or recent case in West African history. For instance, Cameroon has experienced recent domestic unrest from widely varied segments of its population, which have included: strikes by students over increases in their university stipends, nation-wide discontent over increasing school fees and the rate of inflation, and ethnic/sectoral rivalry in the form of demands by Cameroon's Anglophone district for more political autonomy and a greater share of the oil money. [Ref. 110: p. 5] Both the Biafra and Cabinda secessionist movements had strong oil and ethnic motives behind them. [Ref. 111: p. 6] Gabon had to invoke stern anti-graft and corruption measures to counter a growing crime wave; while the greatest threat to Nigeria's security is seen as coming from a general breakdown of law and order. [Ref. 105: p. 12] Finally, by allowing the gap between the rich and the poor to become excessive, every oil exporting country runs the risk of a Lt. Rawlings style "puritanical revolution." In sum, the near-term implications for domestic

tranquility in West Africa's oil exporting countries does not look favorable.

B. REGIONAL

The advent of West African oil production has also had an impact on the stability of the region's interstate relations. West African politicians and academics alike have conjectured that petroleum development would have a beneficial effect on regional stability, because it would motivate the oil exporting countries to protect their material prosperity by developing effective military establishments to defend their borders, and by promoting diplomatic and economic co-operation to reduce the overall potential of threat. Although this argument is plausible, history has not been kind to it. In the first place, the oil exporters who have tried to develop effective military organizations have done so in the same manner that they have used to develop their other infra-structural components -- they have tried to buy development, and as a result, there are some incredibly expensive and ineffective military establishments in West Africa, some of which cannot even project a sustainable force to their own borders. [Ref. 112: p. 10]

At any given time, it is not unusual to find 15 to 20 wars, border clashes, and/or guerrilla conflicts raging in Africa, and the West Africans have not been reluctant to engage in their fair share of the continent's imbroglios.

The discovery of oil, which has sensitized every country in the region to the potential of an oil "El Dorado" in their backyard, has heightened tensions along fuzzy borders, imprecisely demarcated by former colonial rulers; and today there are a number of potentially dangerous oil-fueled territorial disputes brewing in West Africa.

In the Gulf of Guinea, Nigeria, Cameroon, Equatorial Guinea, and Gabon are the closest of neighbors, but the territorial scramble for oil resources has caused them to drop all pretenses of being good neighbors. Nigeria and Cameroon are embroiled in a six-year dispute over the oil rich, swampy Rio del Ray region, where Cameroonian gendarmes killed five Nigerian soldiers during a night riverine patrol on 16 May 1981. Although Cameroon's President Ahidjo has decided to pay compensation to the families of the Nigerian victims, agreement on the precise location of the old German-British border has not been reached. [Ref. 113: p. 3] The situation was made more explosive in July by Nigerian accusations that Cameroon was extracting oil from the Nigerian side of the Lake Chad Basin. [Ref. 114: p. 1735]

To make things more interesting, Equatorial Guinea began prospecting for oil in the same general area in 1981 and immediately became involved in a dispute with Gabon over the rights to a potential petroleum area off the island of Corisco. While that dispute, also involving Spain and France, was being negotiated, Hispanoil, in a joint venture with

Equatorial Guinea, began drilling in the vicinity of the Nigerian and Cameroonian oil fields off Biko Island. Borders in the area have never been formally agreed upon and the situation is ripe for a three-way conflict. [Ref. 59: p. 149; 111: p. 7]

Further north, along the Atlantic seaboard, three countries are jostling each other over the ownership of offshore areas with oil potential. Senegal and Guinea-Bissau are arguing over the rights to the Flor Dome oil deposit. The dispute stems from an agreement between France and Portugal, during the colonial period, which placed a portion of Guinea-Bissau's territorial waters under the administrative control of Senegal. Since neither France nor Portugal ever ratified the agreement, Guinea-Bissau has attempted to reassert its sovereignty over the area; Senegal, on the other hand, claims the territory was ceded to them, and the dispute remains unresolved. To the south, Guinea-Bissau is contesting an offshore territorial claim by Guinea. When colonialism came to an end it was generally agreed that the frontiers of African coastal states would extend seaward at roughly right angles to the coastal baseline; however, Guinea's Sekou Toure thinks otherwise, and he has laid claim to a large wedge of Guinea-Bissau's offshore area. Guinea-Bissau has hotly denied Toure's claims; so far no physical blows have been struck. As a result of their colonial heritage, Senegal, Guinea, and Guinea-Bissau have limited their petroleum exploration efforts to non-contested zones. [Ref. 115: p. 1]

The concepts of national dignity, economic independence, and state sovereignty are shared by every West African petroleum exporting country, and expectations of their realization have been magnified by the development of petroleum. This is evident not only in economic development, food production, and petroleum export issues, but also in such concerns as domestic and regional security issues. However, if the historical patterns discussed above remain consistent, most of these countries will sooner or later face the Nigerian dilemma of increasing dependence rather than growing independence. Their wealth will increase as exports of petroleum rise, but so will their dependence upon Western markets for petroleum, and upon the developed nations for their technical know-how, equipment, and capital. In short, politically, as well as economically, rising oil production will almost certainly prove to be a mixed blessing for the nations of West and Central Africa.

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